PB82-910209

SELECTED WATER RESOURCES ABSTRACTS

VOLUME 15, NUMBER 9
SEPTEMBER 1, 1982

W82-03751 -- W82-04250
CODEN: SWRABW

U.S. DEPARTMENT OF THE INTERIOR
OFFICE OF WATER RESEARCH AND TECHNOLOGY

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A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

APPLICATION OF INFILTRATION THEORY FOR THE DETERMINATION OF EXCESS RAINFALL HYETOGRAPH,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Morel-Seytoux.
Water Resources Bulletin, Vol 17, No 6, p 1012-1022, December, 1981. 7 Fig, 9 Tab, 17 Ref.

Descriptors: *Infiltration, Rainfall, Ponding, *Excess rainfall, *Streamflow, *Rainfall intensity, Hydrology, Soil water, Runoff, Interception, *Rainfall-runoff relationships.

Four methods of calculating infiltration rates and excess rainfall rates were compared using simultaneous data on rainfall and streamflow for a watershed. The ponding time approach, which has not been widely used outside of complex computer watershed models, was the most practical for everyday hydrologic practice, needing only a few parameters. Mini-computers or hand held programmable calculators may be used for the calculations. Other methods described and evaluated were: (1) the theta-index method, a trial and error procedure, (2) Horton's equation, which compares the rainfall rate to the infiltration capacity as predicted by an equation, and (3) the Green and Ampt model. As a group these three equations have several limitations: dependence on rainfall intensity and difficulty in positioning the infiltration curve for rainfall rates below the calibrated infiltration capacity. (Cassar-FRC)
W82-03752

DISCUSSION OF 'FINITE ELEMENT METHOD FOR DIRECT RUNOFF FLOW',
Camp Dresser and McKee, Inc., Annandale, VA.
R. J. Dever, Jr.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY3, p 381-382, March, 1981. 1 Ref.

Descriptors: *Hydrologic models, *Rainfall-runoff relationships, *Runoff forecasting, Mathematical models, Mathematical equations, Momentum equation, Continuity equation, Watersheds, Runoff, Hydrology, Hydrologic systems, Rainfall infiltration, Rainfall disposition, *Finite element method.

This review of the article 'Finite Element Method for Direct Runoff Flow' states that the model for the application of the Galerkin finite element method to the simulation of time-dependent rainfall-runoff as presented in the article includes a deficiency serious enough to render the model unacceptable for practical applications. While the authors of the article, M. Kawahara and T. Yokoyama, have solved the time-dependent, two-dimensional equations of momentum and continuity for rainfall-runoff, the equation of continuity is stated incorrectly for practical problems such as the Tenryu River Ina Basin example used in the paper. The authors failed to take into account the significant rainfall losses that occur on all watersheds, including infiltration, surface depression storage, and interception by vegetal cover. The equation of continuity presented in the subject article must be modified to include a loss term. It is argued that the authors have allowed sophisticated mathematical solutions to become an end in themselves, presenting an impressive example of the numerical solution of differential equations while failing to properly state the most basic principle in all hydraulic and hydrologic models, the principle of continuity. (See abstract No. W80-04832 for subject paper) (Carroll-FRC)
W82-03782

WATERSHED MODEL STUDY USING LANDSAT IMAGE DATA,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
T-P. Chang.
PhD Thesis, 1981. 336 p, 71 Fig, 28 Tab, 121 Ref, 8 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-26421.

Descriptors: *Model studies, *Watersheds, *Remote sensing, Computer models, Computer programs, Hydrology, Hazards, Landslides, *Satellite technology, *LANDSAT.

A large quantity of updated information on the physical characteristics of a huge area can be expediently reduced, without significant time-lag, through the scan of remote sensors on board spacecraft platforms. In connection with the use of remote sensing techniques, a digital terrain model that characterizes geometric features and other terrain conditions of a watershed is also necessary for watershed modeling. With these viewpoints and considerations, four submodels that link the processing of the remote sensed data to the watershed analysis have been developed in this study. The submodels are LANDSAT image data processing model(LIDPM), digital terrain model (DTM), hydrologic simulation model (HSM), and landslide-hazard potential delineation model (LPDM). The structure, function, and computer programs related to these models, along with the results of watershed simulation using the models, are presented and discussed. (Sinha-OEIS)
W82-03814

NITROGEN DYNAMICS IN THE SURFACE WATERS OF THE NEW JERSEY PINE BARRENS,
Rutgers - The State Univ., New Brunswick, NJ.
B. J. Zimmer.
PhD Thesis, May, 1981. 323 p 49 Fig, 15 Tab, 282 Ref, 4 Append, University Microfilms International, Ann Arbor, MI; Order No GAX81-22143.

Descriptors: *Watersheds, *Surface water, *Nitrogen cycle, Groundwater, *Nutrients, Sediment, Swamps, Nitrification, *New Jersey Pine Barrens.

Eight aspects of nitrogen dynamics were investigated in disturbed and undisturbed watersheds in the New Jersey Pine Barrens during 1978-1980. These included nutrient concentrations in the stream, discharge rates, nutrient concentrations in the ground water at streamside, organic content of the sediments, rate of ammonium-N release from the sediments, rate of nitrification and ammonification in the water column, and rate of nitrogen loss from the water column to the sediments. The swampy lowlands in the Pine Barrens function as the hydrological link between the groundwater and the stream water, so that water and dissolved nutrients tend to enter the streams in the swamps. In general, larger perturbations are positively correlated with both a greater input of water and nutrients via the swamps and with significantly grater nitrogen loads in the streams. Disturbed drainage basins in the Pine Barrens are unable to effectively conserve nitrogen, while undisturbed drainage basins are able to conserve about 95% of the calculated nitrogen input. (Sinha-OEIS)
W82-03816

A TRIGGER TYPE CLUSTER MODEL FOR FLOOD ANALYSIS,
Purdue Univ., Lafayette.
J. E. Cervantes.
PhD Thesis, May, 1981. 195 p, 29 Fig, 6 Tab, 32 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-23619.

Descriptors: *Model studies, *Flood peak, *Hydrographs, Flood hydrographs, Statistical models, Stochastic process, Streamflow, Rainfall-runoff relationships, Precipitation, Cluster process, *Ohio River Basin.

A two-level and two-dimensional non-homogeneous point stochastic process is developed to model the flood peak occurrences of a hydrograph. The model is a trigger cluster process of the Neyman-Scott type and presents the occurrence of flood generating mechanisms (FGM), at the precipitation level, as the triggers for clusters of flood peaks at the runoff level. The FGM's are studied in terms of the time of occurrence and the volume of what is called the cluster center of the FGM. The statistical properties of the cluster process defined as the total number of flood peaks, are found in terms of the probability generating functional of the process. A statistical methodology is developed to estimate the two-dimensional rate of occurrence of the process and the conditional rate of occurrence of the subsidiary process in the two-dimensions, time and magnitude. Data from several stations in the Ohio River Basin are used for that purpose. The theoretical rate of occurrence, the theoretical covariance density and the theoretical probability mass function of the process are compared to the empirical rate of occurrence, the empirical covariance density and the empirical probability mass function and a good fit is found for the analyzed stations. (Sinha-OEIS)
W82-03818

URBAN RAINFALL-RUNOFF MODELLING USING REMOTE SENSING IMAGERY,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
S. E. Draper.
PhD Thesis, April, 1981. 262 p, 25 Fig, 47 Tab, 80 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-24289.

Descriptors: *Urban watersheds, *Urban runoff, *Model studies, Rainfall-runoff relationships, Remote sensing, Infrared imagery, Hydrograph analysis, *Hartford area, Connecticut, Impervious percentage.

Since research studies have shown a strong correlation between watershed response and the amount of impervious area in the watershed, accurate estimation of this parameter is essential for effective investigation of the urban rainfall-runoff process. The purpose of this research was to demonstrate the application of remote sensing imagery to automatically extract the percent impervious parameter needed for the rainfall-runoff model. Urbanized watersheds near Hartford, Connecticut, were chosen for the study. The impervious percentages of the watersheds were determined by manual methods. Two conceptual models, the Single Linear Reservoir (SLR) and Nash models, were selected for hydrograph simulation. Comparisons were made to determine the sensitivity of the hydrograph estimation model to use of impervious percentages extracted from remote sensing imagery. The statistical performance indices provided by the model using the values of impervious percentages developed from the remote sensing imagery compared favorably with the performance indices provided by the model using values determined manually. Tests indicated no statistically significant differences existed between the two models. The study indicates that the SLR or Nash model can be used for accurately predicting runoff from urban watersheds and that remote sensing imagery can be used for accurately estimating the impervious percentage without the necessity of image-specific training sets and can be used for modelling the urban rainfall-runoff process. (Sinha-OEIS)
W82-03820

THE SIGNIFICANCE OF TROPICAL CYCLONE RAINFALL IN THE WATER SUPPLY OF SOUTH FLORIDA,
Florida Univ., Gainesville. Dept. of Geography.
For primary bibliographic entry see Field 2B.
W82-03821

A DISTRIBUTION FUNCTION APPROACH TO RAINFALL RUNOFF MODELING,
Institute of Hydrology. Wallingford (England)
R. J. Moore, and R. T. Clarke.
Water Resources Research, Vol 17, No 5, p 1367-1382, October, 1981. 11 Fig, 5 Tab, 25 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, Distribution patterns, Distribution, Mathematical models, Streamflow.

An attempt was made to develop a rainfall runoff model with a small number of parameters capable of physical interpretations which would avoid the

difficulties of parameter estimation, provide an explicit form for the calculated streamflow given by the model, and be able to use the large body of statistical theory now available for parameter estimation, hypothesis testing, confidence interval calculation, and incorporating prior or additional information. The basis of the new approach to rainfall runoff modeling involves the use of a statistical population of stores in place of a simple store. An important facet of this new approach is that the discontinuous objective function characteristic of models based on simple stores becomes a continuous objective function which is differentiable at all points in the parameter space when a population of stores is employed. The resulting model has only a few parameters, which are rapidly estimated by fast derivative-based function minimization procedures. Application of this approach to real data has shown that the two parameters of exponential distributions for soil depth and translation time are sufficient to give a remarkably good fit between observed and calculated runoff in most cases during calibration periods. Measures of goodness of fit obtained are only slightly less than the corresponding measures of goodness of fit for a conceptual model with many more parameters. (Baker-FRC)
W82-03845

THE WATER BALANCE IN NEWFOUNDLAND,
Memorial Univ. of Newfoundland, St. John's. Dept. of Geography.
For primary bibliographic entry see Field 7A.
W82-03921

FLOW MODEL OF SAGINAW RIVER NEAR SAGINAW, MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-03996

A NONLINEAR HYDROLOGIC CASCADE,
George Washington Univ., Washington, DC. School of Engineering and Applied Science.
V. P. Singh, and S. Buapeng.
Journal of Hydrology, Vol 51, No 1-4, p 283-293, May, 1981. 4 Fig, 1 Tab, 26 Ref.

Descriptors: *Hydrographs, *Hydrologic models, *Rainfall-runoff relationships, Water storage, *Reservoirs, Runoff, Mathematical models, *Agricultural watersheds.

This paper reports the development of a storage type nonlinear runoff model and its application to natural watersheds. In this nonlinear hydrologic cascade model, the nonlinear cascade represents a watershed by a series of unequal nonlinear storage elements or reservoirs. The model was applied to 38 natural agricultural watersheds representing several regions of the United States. Published rainfall runoff data were used to determine mean areal rainfall and rainfall-excess. Rainfall-runoff events of each of the watersheds were divided into an optimized set and a prediction set. Hydrographs were predicted for each of the events in the prediction sets of several watersheds. These hydrographs indicated that the nonlinear hydrologic cascade can predict watershed runoff staisfactorily. Computation time interval was found to be important for model performance and can be taken as 1 minute. It was not possible to establish reliable correlations between the model parameters and watershed characteristics, and the model parameters had no correlation among themselves. (Carroll-FRC)
W82-04051

ANALYZING THE RISK OF DROUGHT: THE OCCOQUAN EXPERIENCE,
Interstate Commission on the Potomac River Basin, Rockville, MD.
D. P. Sheer.
Journal of the American Water Works Association, Vol 72, No 5, p 246-253, May, 1980. 5 Fig, 5 Tab, 12 Ref.

Descriptors: *Drought, Risks, *Water shortage, *Occoquan Reservoir, Virginia, Fairfax County, *Model studies, Water storage, *Reservoir storage, Water conservation, Water demand, Safe yield, Political aspects, Streamflow.

Risk analysis techniques were used to evaluate the drought problem at Fairfax County, Virginia's, Occoquan reservoir during 1977. The U.S. Geological Survey technique was simpler than the National Weather Service technique for this situation, where snowmelt is not a major factor and groundwater is not influenced by outside factors. The USGS method used a 49 year sequential streamflow record. Twenty-two of the years were chosen for inclusion in the analysis because they met the criteria of years following dry Septembers. Risk estimates generated from this series were twice as great as estimates from the whole historical record. Meetings with an advisory group evaluated the risks. It was decided to implement a 30 ML per day decrease in consumption by voluntary measures rather than by enforcement. Rain began on Oct. 27, and restrictions were ended on Nov. 8, when the reservoir was 1.5 m above the specified safe target level. (Cassar-FRC)
W82-04097

EMPIRICAL INVESTIGATION OF CURVE NUMBER TECHNIQUE,
Science and Education Administration, Columbia, MO.
A. T. Hjelmfelt, Jr.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 105, HY9, p 1471-1476, September, 1980. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Hydrologic models, *Mathematical equations, *Frequency distribution, *Rainfall-runoff relationships, *Flow characteristics, Runoff volume, Streamflow.

A frequency disribution for some flow characteristic is often established in order to meet design requirements of hydrologic analysis. Since most watersheds are ungaged, flow-frequency distributions are commonly estimated from frequency distributions of a rainfall characteristic. Although the curve number technique of the United States Department of Agriculture Soil Conservation Service is widely used to estimate runoff volume from rainfall depth, tests verifying the procedure have not been widely published. This paper investigated the validity of the curve number method as a transformation from rainfall to runoff frequency distributions using the approach applied by Schaake, et al., in their investigation of the rational method as a similar transformation. The published rainfall and runoff event-volumes for five watersheds were ordered by magnitude; a plotting position was established; and the values were plotted on log-normal probability paper. Rainfall was assumed to follow a log-normal distribution and the line indicated was fitted, by the method of moments, to the rainfall data. The fitted rainfall distribution was then transformed to the runoff distribution using the curve number technique. Agreement was found to be quite good in four of the five cases studied. These results indicate that, within limits, the equation used yields the appropriate shape for the runoff frequency distribution assuming lognormal rainfall distribution. (Carroll-FRC)
W82-04112

PROCESS-RESPONSE SYSTEMS: A PRACTICAL APPROACH TO WATERSHED CLASSIFICATION CONSIDERING WATER AND SEDIMENT YIELDS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. J. Parra-Mata.
PhD Thesis, 1981. 569 p 86 Fig, 78 Tab, 254 Ref, 2 Append, University Microfilms International, Ann Arbor, MI; Order No GAX81-19724.

Descriptors: *Watersheds, *Classification, Hydrologic budget, Climates, Ecosystems, Drainage, Slopes, Outlet channels, Land classification, Water yield, Sediment yield, Components.

The classification scheme developed in this study summarizes, integrates, and synthesizes environmental information needed to establish the basis of a watershed classification system, based on their natural attributes and biophysical interrelationships. A diagrammatic framework to interrelate structure and function by watershed modules or components was developed to permit the systematic and consistent evaluation of information, not readily quantifiable, and using only the classification variables. To cope with the level or levels of resolution at which the watershed system can be examined, the watershed components are described by aggregating them into 'modules' according to their functional role in the watershed system, namely: climate, ecosystems, water balance, hillslope-drainage net, outlet channel reach and land system modules. Many of these module-components are further broken down into several subdivisions and through a system of subscripts these parameters are easily expanded to a higher degree or level of resolution if such expansion becomes necessary to examine a particular component or module in more detail. (Sinha-OEIS)
W82-04217

2B. Precipitation

THE SIGNIFICANCE OF TROPICAL CYCLONE RAINFALL IN THE WATER SUPPLY OF SOUTH FLORIDA,
Florida Univ., Gainesville. Dept. of Geography.
D. Brandes.
PhD Thesis, June 1981. 168 p, 9 Fig, 39 Tab, 294 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No. GAX81-27418.

Descriptors: *Hydrologic cycle, *Water supply, *Tropical cyclones, Rainfall, Hurricanes, Hydrologic budget, Water management, *Florida.

Hurricanes and tropical storms are an important part of the hydrologic cycle in South Florida. Although these storms may cause damage to coastal properties and endanger lives, they also bring rainfall to recharged water supplies. If hurricanes fail to influence the rainfall of this region, either because of human intervention by weather modification or because of possible natural climatic change, the water budget is affected. The study of tropical cyclone rainfall for a sixty-year period from 1919 through 1978 reveals that the amount of rain from hurricanes has declined significantly in the last several decades. This decline is discussed in relation to its effects on water supply and management in the South Florida Water Management District. Although declining supplies and increasing consumption portend severe chronic water shortages in the region, the knowledge that hurricanes do not bring as much rain as water management officials had thought should allow more effective use of surface storage reservoirs. (Sinha-OEIS)
W82-03821

GAGE DENSITY AND LOCATION FPR ESTIMATING MEAN ANNUAL PRECIPITATION IN MOUNTAINOUS AREAS,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
M. Molnau, W. J. Rawls, D. L. Curtis, and C. C. Warnick.
Water Resources Bulletin, Vol 16, No 3, p 428-432, June, 1980. 3 Fig, 4 Tab, 7 Ref.

Descriptors: *Precipitation, *Sampling, *Network design, Mountains, *Rain gages, *Idaho, Snow, Mean annual precipitation.

The optimum gage density was determined from analysis of data from 45 precipitation gages in a mountainous region of Idaho. Factors significantly affecting mean annual precipitation were elevation, slope, and cover class. Aspect and hydrological soil classification were not significant in this basin, but should not be ignored when studying other basins. The number of gages can be minimized if gages are placed in areas where precipitation variation is highest. Elevation or cover class, which together account for 64% of the variation in mean

annual precipitation, can be used as a means of stratification. Using less than 20 gages for this watershed produced an unacceptably large confidence interval. (Cassar-FRC)
W82-03901

A SIMPLE METHOD FOR ESTIMATING CONVECTIVE RAIN VOLUME OVER AN AREA,
South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
For primary bibliographic entry see Field 7B.
W82-04201

A TREE-RING RECONSTRUCTION OF DROUGHT IN SOUTHERN CALIFORNIA,
Arizona Univ., Tucson. Lab. of Tree-Ring Research.
D. M. Meko, C. W. Stockton, and W. R. Boggess.
Water Resources Bulletin, Vol 16, No 2, p 594-600, April, 1980. 6 Fig, 4 Tab, 13 Ref.

Descriptors: *Drought, *Dating, *Climatology, Trees, *California, Planning, History, Palmer Drought Severity Index, Water resources development, Long-term planning, Tree rings.

Tree ring indexes from trees at 8 sites in Southern California were used with the Palmer Drought Severity Index to reconstruct drought periods back to 1700 A.D. The results indicated that drought was unusual in the 1900-49 period relative to other 50-year periods in the study. The 1950-63 period had a greater frequency of droughts lasting several years and a greater frequency of extreme droughts. If this trend continues, the second half of the twentieth century may be the driest in 250 years. The two driest single years were 1857 and 1961, followed by 1782, 1965, and 1977. Droughts of extreme, severe, and moderate levels were most common during the two 50-year periods in the 1800's. Two and three year droughts occurred as follows: extreme, 1863-64 and 1898-99; severe, 1752-54, 1963-64, and 1970-72; and moderate, 1794-95, 1812-13, 1819-20, 1822-23, 1870-71, 1898-1900, 1924-25, 1933-34, 1947-48, and 1959-61. (Cassar-FRC)
W82-04229

2C. Snow, Ice, and Frost

MANAGEMENT OF ICE-COVERED RIVERS: PROBLEMS AND PERSPCTIVES,
New Brunswick Univ., Fredericton. Dept. of Civil Engineering.
K. S. Davar, and N. A. Elhadi.
Journal of Hydrology, Vol 51, No 1-4, p 245-253, May, 1981. 5 Fig, 8 Ref.

Descriptors: *River flow, *Ice cover, Ice formation, Rivers, Hydraulic properties, Ice breakup, *Flow characteristics, Ice games, Management planning.

The presence of ice covers on river systems during the winter can have a significant impact on the management of these systems. Management problems posed by such ice covers may relate to the planning, design, or operational phases of a water resources project. Ice covers may take the form of broken cover, ice buildup from the banks, complete and smooth surface ice cover, fragmented and rough surface ice cover, and hanging dams. Problems encountered in the management of ice-covered rivers may comprise physical problems relating to the reduced conveyance capacity of the river channel and to rapid rises in water level when the ice breaks up and jams downstream; hydraulic problems of analysis and design relating to the increased boundary resistance and the decreasing cross-sectional flow area with ice cover growth; and information problems resulting from the difficulty conducting field measurements for the intermediate conditions of broken ice cover or shore-fast ice. Very little information is currently available on the conveyance and dispersive capacities of ice-covered rivers. Laboratory study results can be useful in estimating conveyance and dispersive capacities of an ice-covered river when information on existing flow and roughness conditions is available. However, field studies are necessary to provide the scientific information needed for planning, designing, and real-time river management of major water-resources projects during the ice-covered period. (Carroll-FRC)
W82-03807

SIMULATION OF ICE-COVER GROWTH AND THERMAL DECAY ON THE UPPER ST. LAWRENCE RIVER.
Michigan Univ., Ann Arbor.
G. M. Greene.
PhD Thesis, 1981. 160 p, 22 Fig, 7 Tab, 56 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-25117.

Descriptors: *Model studies, *Ice cover, *Rivers, Ice-water interfaces, Snow, Ice thickness, Ice breakup, Growth, Temperature gradient, Energy balance, River ice, *St. Lawrence River.

The decay and destruction of a river ice cover is a complex process involving mechanical and thermal energy transfer between the ice, the water, and the atmosphere. The purpose of this paper is to describe the structure and application of models designed to stimulate the growth and decay of a highly abstract, one-dimensional ice cover formed on the St. Lawrence River. Two general types of models have been constructed and applied to the river for the 1975-76 winter. Analytic growth models based on the assumption of a linear temperature gradient through the ice achieved close agreement with observed ice thickness. Addition of snow cover or turbulent heat exchange in the air made relatively little difference in the simulation results. An analytic melt model produced a good approximation of ice thickness and the breakup date in the lake-like stretches of the river but not in the faster reaches where turbulent heat exchange between the ice and water would be more significant. The other type of model is based on a rigorous determination of the surface energy balance in order to solve for a surface temperature. While this model accurately simulates the breakup date in a reach of the river with slow currents, it underestimates maximum ice thickness. A second version of a surface energy balance model was also tested. The ability of this model to simulate accurately was highly dependent on assumptions about the water temperature and the magnitide and fluctuations in the under-ice turbulent transfer coefficient. (Sinha-OEIS)
W82-03822

AREAL DISTRIBUTION OF SNOW WATER EQUIVALENT EVALUATED BY SNOW COVER MONITORING,
Eidgenoessische Inst. fuer Schnee- und Lawinenforschung, Davos (Switzerland).
J. Martinec.
Water Resources Research, Vol 17, No 5, p 1480-1488, October, 1981. 6 Fig, 13 Ref.

Descriptors: *Remote sensing, *Snow cover, *Snowmelt, Snow surveys, Snowpack, *Satellite technology, Snow water equivalent, Dinwoody Creek, *Wyoming.

The maximum accumulation of snow and its distribution over a mountain basin in terms of water equivalent can be approximated from Landsat observations of seasonal snow cover disappearance during the melting season. Air temperatures are extrapolated to a detailed system of grid points in a basin, melting degree-days are calculated, and the amount of snow melted up to the point of snow disappearance is determined. The method was applied to Dinwoody Creek, Wyoming, for April 1 and May 1, 1974 and 1976. The results are useful for improved areal estimates of snow water volume for snowmelt runoff forecasts, correction of winter precipitation measurements for water balances, focusing watershed management activities, and as control data for remote sensing experiments. (Cassar-FRC)
W82-03842

SURFACE HEAT LOSS AND FRAZIL ICE PRODUCTION IN THE ST. LAWRENCE RIVER,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
H. T. Shen.
Water Resources Bulletin, Vol 16, No 6, p 996-1001, December, 1980. 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Rivers, *Ice formation, *Heat transfer, Frazil ice, *St. Lawrence River, Heat budget, Freezing, Air temperature, Temperature.

A relationship between air temperature and frazil ice production rates was shown in a study of the open reaches of the St. Lawrence River in New York. Data from the reaches between Ogdensburg-Prescott Boom and the Moses-Saunders Dam were analyzed. An excellent linear correlation was shown between surface heat loss rates and freezing degree days. Other components affecting ice production to a lesser extent were heat exchange with the river bed and frictional heat generated under the ice cover. Total annual ice productions due to surface heat losses are given for the winters 1971-72 to 1978-79 for 3 river reaches. (Cassar-FRC)
W82-03925

GLACIATION AND GROUND WATER.
Water Well, Journal, Vol 35, No 12, p 52-54, December, 1981. 2 Fig.

Descriptors: *Groundwater availability, *Glacial aquifers, Aquifers, Glaciers, Glaciation, Water supply development, Water supply, *Glaciohydrology.

The erosional and depositional activities of glaciers have had a tremendous influence of groundwater availability in the areas covered by the ice and beyond the farthest extension of the ice front. In most of the region the land surface before glaciation was formed by consolidated sedimentary rocks such as limestone and sandstone. Some of the most productive aquifers in the world were deposited by glacial meltwater beyond the ice front or under the ice itself. As the ice melted, massive quantities of water flowed down major drainage systems or sluiceways. Outwash from the glaciers washed down the sluiceways and formed valley trains, consisting mainly of sand and gravel, and usually beginning at an end moraine and extending down valley from it. Valley trains continued to build headward as long as the sluiceways continued to receive glacial meltwaters, even as the ice retreated. Some valley trains are several hundred miles long. Outwash plains were produced by the merging of a series of outwash fans or aprons. Pitted outwash plains are found where ice blocks have been buried beneath the outwash. The ice subsequently melts, resulting in subsidence of overlying material to form what is commonly called a kettle. Persons drilling or evaluating groundwater resources in glaciated parts of the country will probably continue to be frustrated by the heterogeneity of glacial deposits and the difficulty of selecting appropriate sites to drill. (Baker-FRC)
W82-04002

OPERATIONAL APPLICATIONS OF SATELLITE SNOW COVER OBSERVATIONS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 7B.
W82-04150

ON THE RATE OF ICE FORMATION IN WATER COOLED BY A MORE SALINE SUBLAYER,
Goeteborg Univ. (Sweden). Dept. of Oceanography.
A. Stigebrandt.
Tellus, Vol 33, No 6, p 604-609, December, 1981, 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Heat flow, *Ice formation, *Saline water, Pycnocline, Convection, Seawater, Density stratification, Freezing.

When a less saline water mass at its freezing temperature is superimposed on a more saline water mass of a lesser temperature, both water masses have temperatures lower than their respective tem-

peratures for maximal density, and the salinity of both is less than 24.7 o/oo. Since heat diffuses much faster than salt, thermal convection will take place in the two water masses. Heat transferred to the lower layer causes ice formation in the upper layer. In the case of density ratios between 100 and 1000 the heat exchange between layers is controlled by molecular processes in the pycnocline and not by properties of the induced thermal convection in the homogeneous layers. The mean growth rate of ice can be calculated from the temperature difference between the layers, the time during which the process acts, and the final thickness of the pycnocline. Observed mean ice growth rates due to cooling from below varied from 0.00094 to 0.00199 m per day in a series of experiments. (Cassar-FRC)
W82-04190

2D. Evaporation and Transpiration

THE EFFECT OF LEAF WATER STATUS ON STOMATAL ACTIVITY, TRANSPIRATION AND NITRATE REDUCTASE OF SWEET POTATO,
National Provincial Chung-Hsing Univ., Taichung (Taiwan). Dept. of Agronomy.
F. J. M. Sung.
Agricultural Water Management, Vol 4, No 4, p 465-470, December, 1981. 8 Fig, 18 Ref.

Descriptors: *Leaves, *Water potentials, Water stress, Moisture stress, Metabolism, Nitrates, Stress, *Transpiration, Water loss, Stomatal transpiration, *Sweet potatoes.

The response of stomata, transpiration, ant nitrate reductase activity of field grown sweet potato to leaf water status and humidity was investigated. A slight linear increase in leaf diffusive resistance was noted as leaf water potential declined from -4 bar to -14 bar. Both genotypes tested responded similarly, suggesting that there was no genotypic difference. The major factor affecting the stomata activity of sweet potato appeared to be radiation rather than leaf water potential. A higher humidity gradient between leaf and ambient air results in a higher leaf resistance, which appeared to be of sufficient magnitude to be beneficial in reducing water loss. The rise in the humidity gradient between leaf and air resulted in concomitant increases in transpiration rate. Distinct genotypic differences were also noted in the transpiration response to the humidity gradient. Increases in transpiration rates caused a lowering in leaf water potential. A curvilinear relationship between nitrate reductase activity and leaf water potential was noted. The nitrate reductase activity did not change until leaf water potential declined to -6 bar, but it declined rapidly from -7 to 1-4 bars. Peak nitrate reductase activity occurred between 11 and 13:00 hours, coinciding with maximum solar radiation. The study provided evidence of a water stress-induced metabolic disorder in sweet potato, although no water stress-induced stomatal closure was noted. It was concluded that the measurement of leaf resistance is not a reliable estimate of plant water status and related physiological activity in the case of sweet potato. (Baker-FRC)
W82-03793

REFINEMENT OF LAKE EVAPORATION MEASUREMENTS, USING AN ION-BALANCE TECHNIQUE,
Brigham Young Univ., Provo, UT. Dept. of Civil Engineering.
D. K. Fuhriman, and L. B. Merritt.
Journal of Hydrology, Vol 51, No 1-4, p 255-263, May, 1981. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Measurement techniques, *Lake evaporation, Evaporation rate, Evaporation pans, Ions, *Hydrologic budget, *Utah Lake, Ion-balance technique.

An ion-balance technique has been used to refine measurements of evaporation from a relatively shallow lake in Utah. The water balance method can be used as a direct method for the determination of lake evaporation in the rare instances in which it is possible to measure all of the inflow and outflow of the lake. The reported study resulted from the need to accurately determine groundwater inflow to and evaporation from Utah Lake, located near Provo, Utah, in order to evaluate the potential effects of proposed diking of bay areas on water quality. Evaluation of the potential likelihood of measuring each parameter in the water budget equation indicated that groundwater inflow and evaporation could not be measured effectively. Therefore, the water budget equation alone would not permit accurate evaluation of the evaporation from the lake. Significantly different concentrations of major ions, including calcium, magnesium, sodium, potassium, bicarbonate-carbonate, chloride, and sulfate, were found in each major category of inflowing surface and groundwater to the lake. A mass ion-balance equation was written for the lake, similar in form to the water balance equation, for each of the non-precipitating ions. To utilize these equations, it was then necessary to determine total sodium and chloride ions, or any other ion selected, in all of the inflows and outflows, as well as in the lake water at the beginning and end of each accounting period. Detailed field measurements and computer simulations indicated that these equations could be used effectively as a means for solving for some of the unknown elements in the water balance equation. (Carroll-FRC)
W82-03808

MODELING THE EFFECTS OF CONSERVATION PRACTICES ON SOIL MOISTURE,
Minnesota Univ.-Duluth.
For primary bibliographic entry see Field 2G.
W82-03811

EVAPOTRANSPIRATION FROM FORAGE GRASS REPLACING NATIVE VEGETATION IN THE GILA RIVER VALLEY OF ARIZONA,
Geological Survey, NSTL Station, MS. Water Resources Div.
O. E. Leppanen.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $5.50, Microfiche $3.50. Geological Survey Open-File Report 81-1018, 1981. 38 p, 6 Fig, 1 Tab, 6 Ref.

Descriptors: *Evapotransiration, *Soil water, *Forages, Heat balance, Micrometeorology, Transpiration, Grasses, Vegetation effects, *Arizona, Gila River valley.

Estimates of evapotranspiration from an area of forage grass, which had been planted to replace native vegetation of little economic value, were made daily for a 363-day period in 1969 and 1970. The measurement site was located in the Gila River valley in east-central Arizona. The forage, panigrass (Panicum antidotale Retz.), grew from seed during the early summer of 1969 and after winterkill, regrew in 1970. Daily evapotranspiration estimates, which were based on energy budget measurements, ranged from a maximum of 9.2 millimeters to small amounts of condensation. Two daily values of substantial condensation (0.9 and 0.4 millimeter) were of dubious quality, but were retained in the record. The annual evapotranspiration was 989 millimeters, of which about 332 millimeters came from precipitation at the site. The water table fluctuated between 210 and 280 centimeters below land surface. However, the measurement site was near a wash, so that undocumented, shallower subterranean flows may have occurred. (USGS)
W82-03994

2E. Streamflow and Runoff

PALEOFLOOD HYDROLOGY,
State Univ. of New York Coll. at Fredonia. Dept. of Geology.
R. C. Kochel, and V. R. Baker.
Science, Vol 215, No 4531, 353-361, January 22, 1982. 8 Fig, 3 Tab, 36 Ref.

Descriptors: *Flood recurrence interval, *Sedimentology, *Paleohydrology, *Historic floods, Flood frequency, Hydrology, Rivers, *Pecos River, *Devils River, *Texas, Risks, Semiarid lands, Tributaries, Canyons.

A 10,000 year paleoflood record for the lower Pecos and Devils Rivers in Texas was established by a rapid, inexpensive technique which analyzes sediments deposited in tributary mouths by the slack waters of large floods. This method solves the difficulties inherent in estimating recurrence intervals for very large, rare floods in semi-arid regions, for which historical records are generally too short or too sparse. Sites suitable for studying slack water sediments are those protected from erosion. Radiocarbon dating of organic materials entrapped in the sediments provided ages of sediment layers. Hurricane Alice, 1954, with over 100 cm of rain in 48 hours and a similar storm in 1974 have recurrence intervals of 2000 years and 500-700 years, respectively, as determined by the slack water sediment method. Other methods of calculating flood frequency gave recurrence intervals of 80 years to over 10 million years. (Cassar-FRC)
W82-03761

A TRIGGER TYPE CLUSTER MODEL FOR FLOOD ANALYSIS,
Purdue Univ., Lafayette.
For primary bibliographic entry see Field 2A.
W82-03818

INVESTIGATION OF FLUVIAL PROCESSES UNDER CONDITIONS OF NATURAL VARIABILITY OF THE RUNOFF,
For primary bibliographic entry see Field 2J.
W82-03906

FLOODPLAIN MANAGEMENT NEEDS PECULIAR TO ARID CLIMATES,
Utah Water Research Lab., Logan.
L. D. James, D. T. Larson, D. H. Hoggan, and T. F. Glover.
Water Resources Bulletin, Vol 16, No 6, p 1020-1029, December, 1980. 1 Fig, 24 Ref.

Descriptors: *Arid lands, *Flood plain management, *State jurisdiction, *Utah, Flood control, Evaluation, Channeling, Insurance, Nonstructural alternatives, Mountains, Canyons, Alluvial fans, Mapping, Flood plain zoning, Zoning, Cloudbursts.

The national flood control and flood plain management programs designed for humid areas have not been effective in Utah's arid climate. In this region, flood flows dissipate quickly as they emerge from mountain areas to desert lowlands. Cloudburst floods are common. The major risks are in narrow mountain canyons and at the apex of alluvial fans. Flooding at the same location is extremely variable in different storms, and there are long periods between floods. Generally, mapping shows risks too high in the designated flood plains and too low outside. Channelization and irrigation canals have added to the flood hazard. Several examples are given of damaging floods in areas designated flood-free and in areas where canals and roads disturbed natural flow patterns. There are opportunities for the state government to become active in efficient flood plain management planning as a liaison between federal and local governments through coordinating information exchange and providing technical expertise to apply the federal programs to the unique local situations. (Cassar-FRC)
W82-03908

MATHEMATICAL SIMULATIONS OF THE TOCCOA FALLS, GEORGIA DAM BREAK FLOOD,
Geological Survey, Austin, TX. Water Resources Div.
L. F. Land.
Water Resources Bulletin, Vol 16, No 6, p 1041-1048, December, 1980. 5 Fig, 13 Ref.

Descriptors: *Dam failure, *Streamflow forecasting, *Flood peak, Model studies, Mathematical models, *Toccoa Falls, *Georgia, Earth dams, Floods, Forecasting.

The earthen dam failure at Toccoa Falls, Georgia, on November 6, 1977, produced a 22 ft depth and a peak discharge of 23,000 cu ft per sec. Four models were used to simulate the downstream effects. The models were: (1) Modified Puls, (2) U.S. Army Corps of Engineers Gradually Varied Unsteady Flow Profiles (USTFLO), (3) National Weather Service's Dam Break Flood Forecast, and (4) U.S. Geological survey's method of characteristics combined with a general purpose streamflow simulation. Model (2) failed to simulate this case. Model (1) was easiest to use; Model (4) most difficult. Computed peak discharge at the dam ranged from 28,900 cu ft per sec for Model (1) to 43,400 cu ft per sec for Model (4). At a distance of 4.3 miles downstream peak discharges were 8,190 to 10,400 cu ft per sec. Simulated flood crests corresponded within 2 ft to observed high water marks. Computer costs for the models, based on Model (1) as unity, are (3), 5 times greater, and (4) 50 times greater. (Cassar-FRC)
W82-03920

IMPACT OF FLOOD HAZARD ON RESIDENTIAL PROPERTY VALUES IN GALT (CAMBRIDGE), ONTARIO,
Toronto Univ. (Ontario).
For primary bibliographic entry see Field 6B.
W82-03929

DELINEATION OF FLOOD HAZARDS IN THE JAYNES QUADRANGLE, PIMA COUNTY, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-03976

HYDROLOGIC DATA FOR NORTH CREEK TRINITY RIVER BASIN, TEXAS, 1979,
Geological Survey, Austin, TX. Water Resources Div.
C. C. Kidwell.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $4.75, Microfiche $3.50. Geological Survey Open-File Report 81-823, August, 1981. 38 p, 2 Fig, 3 Tab.

Descriptors: *Hydrologic data, *Streamflow, *Rainfall-runoff relationships, Retaining walls, *Floodwater, Gaging stations, Hydrographs, Flood control, Small watersheds, *Texas, *North Creek, Trinity River basin.

This report contains rainfall and runoff data collected during the 1979 water year for the 21.6-square mile area above the stream-gaging station North Creek near Jacksboro, Texas. A continuous water-stage recording gage was installed at one representative floodwater-retarding structure (site 28-A) on Oct. 5, 1972. The data are collected to compute the contents, surface area, inflow, and outflow at this site. The stream-gaging station on North Creek near Jacksboro continuously records the water level which, with measurements of streamflow, is used to compute the runoff from the study area. Streamflow records at this gage began on Aug. 8, 1956. Detailed rainfall-runoff computations are included for one storm during the 1979 water year at the stream-gaging station. (USGS)
W82-03979

FLOODFLOW CHARACTERISTICS OF THE SACRAMENTO RIVER IN THE VICINITY OF GIANELLA BRIDGE, HAMILTON CITY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. C. Blodgett.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $7.75 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-328, May, 1981. 33 p, 12 Fig, 5 Tab, 15 Ref.

Descriptors: *Flood flow, Flow characteristics, *Bridges, *Channel morphology, Streamflow, Data collections, Channel flow, Flow velocity, Bridge design, Erosion, Channel scour, Distribution patterns, Flood plains, Overflow, Flood routing, Flood profiles, Flood frequency, Flood recurrence interval, *California, *Hamilton City, Sacramento River.

Floodflow, channel, and geomorphic data were assembled to evaluate the characteristics of flooding of the Sacramento River at the Gianella Bridge on State Highway 32 at Hamilton City, Calif. The bridge, constructed with a large center pier and drawrest structure in 1908, constricts floodflows at the site. Variations in river sinuosity, slope, and alinement between 1946 and 1980, indicate that channel changes are significant during short (2- or 3-year) intervals of time. Over long periods, however, the channel appears to be in equilibrium. The flood plain extends several miles upstream and downstream from the site. Soils on the flood plain are sandy-silt loam, easily eroded by streamflow. Overflow to the flood plain is limited by levees along both banks that are overtopped or bypassed when floods exceed 130,000 cubic feet per second in the main channel. Backwater in the main channel upstream from the bridge is about 0.6 feet for flows exceeding 159,000 cubic feet per seconds, and extends more than 1.9 miles upstream, depending on the magnitude of flooding. The bridge structure occupies about 12 percent of the channel during all flows. The distribution of flow at the bridge is affected by piers for about 13 percent of the channel width. Highest velocities of flow are 13 feet per second. (USGS)
W82-03985

REVISED TECHNIQUES FOR ESTIMATING MAGNITUDE AND FREQUENCY OF FLOODS IN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
C. Parrett, and R. J. Omang.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $10.25 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-917, September, 1981. 66 p, 21 Fig, 1 Plate, 4 Tab, 16 Ref.

Descriptors: *Flood forecasting, *Flood peak, *Flood frequency, *Mathematical studies, Regression analysis, Streamflow, Flood discharge, Gaging stations, Sites, Estimating, *Montana, Ungaged sites.

Relations for estimating the flood magnitudes for ungaged sites in Montana have been updated. The State was divided into eight regions and separate multiple-regression equations for each region were developed that relate logarithms of annual flood magnitude to logarithms of basin characteristics for exceedance probabilities of 50, 20, 10, 4, 2, and 1 percent. The standard errors of estimate for an exceedance probability of 1 percent ranged from 39 to 58 percent in the western and central parts of the State and from 47 to 83 percent in the eastern part. The standard errors of estimate indicate a substantial improvement over previous studies. Techniques for transferring annual flood-frequency information at gaged sites to ungaged sites on the same stream have been updated. Included are curves relating flood-frequency information to drainage area for eight major streams in the State. Maximum known flood peaks in Montana are compared with estimated 1-percent-chance flood peaks and with national maximum known flood peaks. Values of flood discharges for selected exceedance probabilities and values of significant basin characteristics for all gaging stations used in the analysis are tabulated. Included are data for 339 stations in Montana and 34 nearby stations in Canada and adjoining States. (USGS)
W82-03987

FLOW MODEL OF SAGINAW RIVER NEAR SAGINAW, MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
D. J. Holtschlag.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.25 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-1061, September, 1981. 20 p, 14 Fig, 3 Ref.

Descriptors: *Model studies, Surface water, *Streamflow, *Flow characteristics, Unsteady flow, Seiches, Open-channel flow, Hydraulic models, Hydrodynamics, Simulation analysis, Calibrations, Boundary conditions, Wind velocity, *Michigan, *Saginaw River.

An unsteady-flow simulation model was applied to a 19.5-mile reach of Saginaw River. The model provides a method of determining instantaneous discharge for flows from -8,000 to 12,000 cubic feet per second. The currently used slope-rating method can be utilized to compute discharge only under steady and high-flow conditions. Unsteady flow frequently occurs in the Saginaw River as a result of lake seiching. Model computations are based on solution of the continuity and momentum flow equations, on hydraulic characteristics of Saginaw River, and on time-dependent boundary conditions. An implicit, finite-difference technique is used to solve the one-dimensional flow equations. Channel storage and conveyance characteristics were obtained from data collected during a 1979 field survey and through model calibration. Boundary conditions are specified by stage or discharge data at the model extremities. Optionally, wind velocity data are incorporated in the flow simulations. The model can simulate instantaneous stage and discharge data and summarize or plot the data. Simulations of low-flows are sensitive to small errors in stage data and to gentle breezes. Simulation of high flows for present channel conditions requires additional data and further study. (USGS)
W82-03996

RAINFALL-RUNOFF HYDROGRAPH AND BASIN CHARACTERISTICS DATA FOR SMALL STREAMS IN OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
D. L. Bergman, and T. L. Huntzinger.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $42.00, Microfiche $4.00. Geological Survey Open-File Report 81-824, September, 1981. 318 p, 2 Fig, 3 Tab, 4 Ref.

Descriptors: *Rainfall-runoff relationships, *Small watersheds, *Data collections, Streams, Crest gages, Gaging stations, Sites, Detention reservoirs, Storm runoff, Floodwater, Flood control, Unit hydrographs, *Oklahoma.

Rainfall with concordant runoff events recorded at 45 gages located in drainage basins of less than 30 square miles in Oklahoma are summarized. Selected basin characteristics which relate to storm runoff are described and tabulated for each gage site summarized. A tabulation is included which identifies drainage basins that produce atypical rainfall-runoff distribution as a result of regulation by upstream flood-retention structures. (USGS)
W82-03999

USE OF PRE-FABRICATED PARSHALL FLUMES TO MEASURE STREAMFLOW IN PERMAFROST-DOMINATED WATERSHEDS,
Pacific Northwest Forest and Range Experiment Station, Fairbanks, AK. Inst. of Northern Forestry.
For primary bibliographic entry see Field 7B.
W82-04074

EMPIRICAL INVESTIGATION OF CURVE NUMBER TECHNIQUE,
Science and Education Administration, Columbia, MO.
For primary bibliographic entry see Field 2A.
W82-04112

GEOMETRY OF GRAVEL STREAMS,
San Diego State Univ., CA.
H. H. Chang.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY9, p 1443-1456, September, 1980. 8 fig, 23 Ref.

Descriptors: *Gravel, *Streams, Stream profiles, Mathematical equations, Streamflow, Streambeds,

Bankfull stage, *Sediment transport, Channel forming, Velocity, *Channel morphology.

A natural stream will choose its own width, depth, slope, roughness, and so forth, in its effort to maintain a balance between its ability to transort and the load provided. The analysis presented in this paper is confined to the equilibrium geometry of straight streams with a mobile gravel bed at bank-full (channel forming) discharge. A rational method is developed to predict the regime geometry of these straight active gravel streams. The analytical geometry used is based upon a resistance equation, a bed load equation, and the minimum stream power condition for alluvial channels in equilibrium. The analytical regime channel width was found to vary with water discharge; and, except for steep slopes, the width was not sensitive to the channel slope. The average channel depth was found to be proportional to water discharge and inversely proportional to the slope. At steep slopes, the channel width increases rapidly with the slope, accompanied by a decrease in depth. The mean velocity for regime gravel channels is predicted to vary with bank-full discharge and channel slope. The sediment load for a regime channel varies proportionally to the discharge and slope. In comparison with field data, the analytical channel widths tend to be smaller for large streams but greater for small streams, while the analytical depths tend to be greater for large streams but smaller for small streams. (Carroll-FRC)
W82-04113

THE AQUATIC INSECTS OF THE NARRAGUAGUS RIVER, HANCOCK AND WASHINGTON COUNTIES, MAINE,
Maine Univ. at Orono. Land and Water Resources Center.
T. M. Mingo, and K. E. Gibbs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-202128, Price codes: A04 in paper copy, A01 in microfiche. Technical Bulletin 100, September, 1980. 63 p, 1 Fig, 140 Ref. OWRT A-028-ME(4).

Descriptors: *Aquatic insects, Rivers, Surveys, *Narraguagus river, Hancock County(ME), Washington County(Me), Maine, *Systematics, Classification, Taxonomy.

An aquatic insect fauna survey was made on the east branch of the Narraguagus river and selected tributaries. The inventory revealed the presence of a rich and diverse aquatic insect fauna. The inventory contains 333 species, representing 193 genera, 75 families, and 10 orders of insects. The inventory includes six new national distributional records and 27 new state distributional records. In addition, five previously undescribed species were collected.
W82-04167

EFFECTS OF A NORTH CENTRAL WASHINGTON WILDFIRE ON RUNOFF AND SEDIMENT PRODUCTION,
Pacific Northwest Forest and Range Experiment Station, Wenatchee, WA.
J. D. Helvey.
Water Resources Bulletin, Vol 16, No 4, p 627-634, August, 1980. 7 Fig, 4 Tab, 15 Ref.

Descriptors: Forest fires, *Runoff, *Soil erosion, Forest hydrology, Forest watersheds, Entiat Forest, *Washington, Streamflow, *Sediment yield, Erosion, Stream erosion, Flow duration, Vegetation effects, Environmental effects.

This paper reports the changes in runoff and sediment production in the seven years after a 1970 wildfire in the Entiat Experimental Forest, Washington. Nine years of stream gage data (1961-70) and records from the unaffected Chelan River were available for comparison. Very early effects and first and second year effects were reported in previous papers. During 1972-77 runoff from the burned area was 10.7 to 47.2 cm greater than measured pre-fire values. Flow duration curves showed that the runoff at each percent value after the fire was about double the comparable pre-fire value. The control river had nearly the same average annual runoff and minimum flow before and after the fire, showing that there was no great change in climate or hydrology in the area. Increases in runoff were caused by the change from mature conifer forest to ground devoid of litter or cover, decreased evaporation and interception, and earlier snowmelt caused by reduced shading. Sediment production increased dramatically after the fire, exceeding the capacity of the measuring devices in some years. This was caused by increased flow rates, increased overland flow, greater stream energy, and mass soil movement. Sediment production was worst in 1972, a wet year only two years after the fire. In 1976 sediment production was 8-, 10-, and 30-fold greater than average pre-fire values in 3 watersheds in the forest. Average total sediment estimates (in kg per ha) from the 3 watersheds in the burned area ranged from 13 to 39 in 1967-70, 261 in 1971, 2353 in 1972, 328 in 1975, 366 in 1976, and 164 in 1977. The decrease with time is a result of depletion of eroded material and increases in vegetation along stream banks. It is expected that increased runoff will continue until the trees form a closed canopy and reach the height of several meters in about 40-50 years. (Cassar-FRC)
W82-04250

2F. Groundwater

IMPACTS OF SURFACE DRAINAGE ON GROUND WATER HYDRAULICS,
Louisiana State Univ., Baton Rouge. Dept. of Marine Sciences.
For primary bibliographic entry see Field 4C.
W82-03753

CHEMICAL AND HYDROLOGICAL HETEROGENEITY OF GROUNDWATERS IN THE UPPER 'JURA NEUCHATELOIS', SWITZERLAND. (HETEROGENEITE CHIMIQUE ET HYDROLOGIQUE DES EAUX SOUTERRAINES D'UN KARST DU HAUT-JURA NEUCHATELOIS, SUISSE),
Neuchatel Univ. (Switzerland). Inst. de Geologie.
For primary bibliographic entry see Field 2K.
W82-03794

FLOW-SYSTEM CONTROLS OF THE CHEMICAL EVOLUTION OF GROUNDWATER,
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 2K.
W82-03795

GEOCHEMICAL INPUTS FOR HYDROLOGICAL MODELS OF DEEP-LYING SEDIMENTARY UNITS: LOSS OF MINERAL HYDRATION WATER,
Illinois Univ., Urbana-Champaign. Dept. of Geology.
D. L. Graf, and D. E. Anderson.
Journal of Hydrology, Vol 54, No 1-3, p 297-314, December, 1981. 112 Ref.

Descriptors: *Groundwater, *Hydrodynamics, *Hydration, Mineralization, Sedimentation, *Model studies, Chemical analysis, Geochemistry, Zeolites, *Geochemistry, *Geohydrology.

This paper considers the amount and quality of information about one of the slow processes, loss of hydration water from sedimentary minerals, that is available for input into hydrological models. The incorporation of appropriate mineral dehydration reactions into a particular hydrological model involves not only mineralogical and geochemical relationships, but also a good deal of regional geologic history. The onset of dehydration is sensitive to geothermal gradient, sedimentation rate, pore-fluid salinity, and degree of overpressuring, values for all of which must somehow be estimated throughout a geologic time interval that begins with the deposition of the stratigraphic interval of interest. Some of the hydrates, such as the zeolites and hallosite, are found only in particular geologic facies. Some, such as analcime and smectite, will follow different decomposition reactions and therefore lose water at different temperatures, depending on whether certain other minerals are present locally in adequate amount for chemical reaction to occur. This situation should lead to stimulating research collaboration between hydrologists and geochemists. However, a process such as mineral dehydration that is strongly dependent upon geologic detail will not be as useful in discriminating among competing models as would a substantially independent process such as radioactive decay. The discussions of individual hydrates in this paper relied mainly on experimentally measured solubilities and mineral interconversions and on field observations as criteria for defining thermodynamic stability fields. Thermochemical measurements, which were used from time to time, could form the entire basis of the argument if all the values needed were available. This latter approach is praticularly attractive for hydrates that occur as large, well-formed crystals, such as zeolites. (Baker-FRC)
W82-03796

THE RATE OF FLUSHING AS A MAJOR FACTOR IN DETERMINING THE CHEMISTRY OF WATER IN FOSSIL AQUIFERS IN SOUTHERN ISRAEL,
Ben-Gurion Univ. of the Negva, Beersheba (Israel). Inst. for Desert Research.
For primary bibliographic entry see Field 2K.
W82-03799

CHEMICAL EVOLUTION OF GROUNDWATER IN A DRAINAGE BASIN OF HOLOCENE AGE, EAST-CENTRAL ALBERTA, CANADA,
Alberta Research Council of Alberta Edmonton. Groundwater Div.
For primary bibliographic entry see Field 2K.
W82-03800

METHANE IN GROUNDWATER AND ITS EFFECT ON 14 C GROUNDWATER DATING,
Niedersachsisches Landesamt fur Bodenforschung, Hannover (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W82-03801

A STUDY OF INTERGRANULAR AND FISSURE PERMEABILITY IN CHALK AND PERMIAN AQUIFERS, USING DOUBLE-PACKER INJECTION TESTING,
Institute of Geological Sciences, Wallingford (England).
M. Price, B. Morris, and A. Robertson.
Journal of Hydrology, Vol 54, No 4, p 401-423, January, 1982. 5 Fig, 1 Tab, 23 Ref.

Descriptors: *Aquifer characteristics, *Measuring instruments, Injection, Boreholes, *Geohydrology, Permeability, Geologic fractures, *Hydraulic conductivity, Borehole logging, Cores, Cameras, *England.

Double-packer injection tests have been carried out in a borehole in the Chalk of Hampshire and a borehole in the Permian Penrith Sandstone of Cumbria, England to ascertain the variation of hydraulic conductivity with depth within these rock formations. Borehole logging and television inspections and laboratory measurements on cores were used to supplement the tests. The results were calculated for injection test intervals containing fissures by a new mathematical treatment. As a localized active method, injection testing has the advantage over other methods such as borehole logging that all permeability variations will be detected, regardless of whether a natural head difference is present to cause flow in or out of the borehole. Preliminary geophysical logging is advisable before injection testing if packers are to be placed at intervals where they will form an effective seal and are not to be seated against fissures. The use of double-packers after completion of drilling is to be preferred to the use of single-packer techniques during the drilling program. These studies have indicated that relatively few fissures contribute a major proportion of the transmissivity around the test boreholes at these sites. Other fissures may cause moderate anomalies on temperature and conductivity logs but make small contributions to the transmissivity. In the Penrith

Sandstone study good agreement was noted between values of intergranular permeability measured on core samples in the laboratory and measurements made in situ in unfissured intervals. In the Chalk study the discrepancy between laboratory and in situ measurements suggests that some minor degree of fissuring is always present. (Baker-FRC)
W82-03804

GROUND WATER CHEMISTRY AND HYDROCHEMICAL FACIES DISTRIBUTION AS RELATED TO FLOW IN THE MISSISSIPPIAN CARBONATES, HARRISON COUNTY, INDIANA,
Indiana Univ. at Bloomington. Dept. of Geology.
P. U. M. Amadi.
PhD Thesis, April, 1981. 361 p, 87 Fig, 23 Tab, 131 Ref, 6 Plate, 7 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-19026.

Descriptors: Groundwater, Geology, *Groundwater movement, *Chemical properties, Hardness, Aquifers, Carbonates, *Geohydrology, *Geochemistry, Missippian carbonates, Harrison County, *Aquifer characteristics, *Indiana, Water chemistry, Hydrochemical facies.

Harrison County, Indiana is unglaciated and has a multi-phased aquifer system which may be interconnected or independent, depending on local hydrologic setting. The ground water generally flows northeast-southwest, sub-parallel to the regional structure and surface drainage. Well yields vary directly with changes in hydraulic gradient and hydraulic conductivity; however, aquifer transmissibility and storage coefficient are higher in the sand/gravel unit than in the carbonates. The hydraulic gradient varies from about 18 ft/mile to 20 ft/mile in the recharge plains to over 50 ft/mile near the discharge basins. The ground water is buffered by calcite, dolomite, kaolinite, gibbsite, quartz, K-feldspar, Albite, fluorite, Ca- and Mg-montmorillo-ite. Changes in chemistry with flow are also related to mineral equilibrium boundaries. The dominant chemical character, carbonate hardness, Ca++/Mg++ ratio, mineral saturation indices, bedrock chemistry and mineralogy and factor analysis of variables suggest that the ground-water chemistry is determined by a number of factors. These factors include carbonate dissolution, variable lithology, oxidizing-reducing processes, flow system, variable aquifer characteristics, weathering and hydrolysis of silicates. Chemical changes respond to the interaction of these factors which collectively control the hydrochemical facies distribution. (Sinha-OEIS)
W82-03810

TWO-PHASE FLOW SIMULATION OF AIR STORAGE IN AN AQUIFER,
NUS Corporation, Rockville, MD.
D. Meiri.
Water Resources Research, Vol 17, No 5, p 1360-1366, October, 1981. 7 Fig, 17 Ref.

Descriptors: *Aquifer characteristics, *Air masses, Model studies, Mathematical models, Simulation, flow, Multiphase flow, *Air-water interfaces, Withdrawal, Groundwater recharge.

The application of two-phase flow analysis to simulate air storage in an aquifer was investigated. The nonlinear partial differential equations describing two phase flow of air and water through porous media are solved by a Galerkin finite element method. The model is employed to simulate the performance of a storage aquifer during a daily air cycle. The air-water displacement and the effects of variations of reservoir permeability on the system have been investigated. The results obtained realistically describe a variable volume storage system with only a small change in pressure. The following conclusions were reached. The porous aquifer selected as an underground storage reservoir for a compressed air storage system acts like a large elastic container in which volume and pressure change during injection and withdrawal cycles. After air storage development and during operation, about 20 to 50% of the residual interstitial water remains in the air zone, causing reduced air storage capacity and air deliverability. Reservoir permeability appears to be a very important characteristic in determining the rate of water displacement and air deliverability. The rate of water migration increases with increasing permeability, the thickness of the transition zone narrows, and the amount of interstitial water remaining in the air zone decreases. Under the condition of constant mass flow rate of air during injection and withdrawal periods, changes in reservoir permeability show significant effect on the pressure distribution. Decreasing permeability increases the pressure gradient, while increasing permeability leads to a more stable pressure distribution in the reservoir. (Baker-FRC)
W82-03841

THE VALUE OF EXPLORATORY TEST HOLES IN GROUND WATER DEVELOPMENT,
C. Carpenter.
Water Well Journal, Vol 35, No 11, p 68-69, November, 1981.

Descriptors: *Test wells, *Aquifer characteristics, *Exploration, Wells, Drilling, Groundwater potential, Case studies, *Utah.

Test holes drilled prior to constructing production wells can be valuable for providing data on aquifer depth, thickness, and characteristics and on water temperature and quality even in areas for which many drillers' reports are available. Three case histories are given. In Utah a test hole, drilled in fractured limestone and quartzite at a site desired by a mining company, was dry. Two subsequent test wells in an alluvial deposit yielded data for design of successful production wells. A municipality in Utah constructed two large production wells in alluvial river deposits where many wells had been located. Much drilling data was available. These wells penetrated materials of variable nature, and expensive design changes were necessary to complete the production wells. Test holes would have saved money in this case. A water district planning wells in Navajo sandstone used test wells to find fractured and broken zones with good secondary permeability. Primary permeability in sandstone is low. In most cases test wells cost about 10-15% of the total well project costs. (Cassar-FRC)
W82-03896

USE OF LONGITUDINAL CONDUCTANCE IN ESTIMATING TRANSMISSIVITY OF GRANULAR AQUIFERS IN NORTHERN MISSOURI,
Missouri Univ.-Columbia. Dept. of Geology.
C. M. Keefe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-195090, Price codes: A08 in paper copy, A01 in microfiche. MA Thesis, May, 1981. 149 p, 52 Fig, 8 Tab, 47 Ref, 3 Append. A-129-MO(1), USDI-OWRT-14-34-0001-0127.

Descriptors: *Electrical resistivity, Longitudinal conductance, *Transmissivity, Granular aquifers, Missouri, Geophysics, Dar Zarouk parameters, *Groundwater movement, *Aquifer systems, *Electrodes, Flow measurement, Salinity.

Longitudinal conductance is an electrical property that can be determined graphically from electrical sounding curves. An inverse relationship between this parameter and transmissivity for granular aquifers was mathematically derived. This relationship was then used to develop a technique of hydrogeologic investigation. This technique also involves corrections for variations in groundwater salinity and clayey confining layers. Both modern and preglacial alluvial channels in northern Missouri were investigated by this method. The field results verify the theoretical relationship. The field results also clearly show the effects of the channel walls on resistivity. Previous investigations in northern Missouri have met with only partial success because of the difficulty in separately determining resistivity and thickness of beds in this region. This technique eliminates the need for resolution of these parameters, as long as the aquifer under investigation is granular.
W82-03957

GEOLOGIC STRUCTURE, HYDROLOGY, AND WATER QUALITY OF THE LARAMIEFOX HILLS AQUIFER IN THE DENVER BASIN, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div., and Colorado Dept. of Natural Resources, Denver.
For primary bibliographic entry see Field 7C.
W82-03978

ANNUAL WATER-RESOURCES REVIEW, WHITE SANDS MISSILE RANGE, NEW MEXICO, 1980,
Geological Survey, Albuquerque, NM. Water Resources Div.
R. R. Cruz.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Paper copy $4.00, Microfiche $3.50. Geological Survey Open-File Report 81-921, August, 1981. 27 p, 11 Fig, 5 Tab, 8 Ref.

Descriptors: *Wells, *Pumping, *Water yield, *Water quality, *Groundwater, Water level fluctuations, Potentiometric level, Water analysis, Chemical analysis, Observation wells, Boreholes, Aquifer management, Hydrologic data, *New Mexico, *White Sands Missile Range, Military reservations, Water supply.

Ground-water data were collected in 1980 at White Sands Missile Range in south-central New Mexico. The total water pumped at White Sands Missile Range in 1980 was 725,053,000 gallons, which was 32.5 million gallons more than in 1979. The Post Headquarters well field, which produces more than 98 percent of the water used at White Sands Missile Range, pumped 712,909,000 gallons, which was 31.1 million gallons more in 1980 than in 1979. Data were collected for specific Range areas north of the Post Headquarters area that might have potential for future water-supply development. (USGS)
W82-03980

MAP SHOWING THE POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER IN SOUTHERN MARYLAND, AUGUST 1980,
Geological Survey, Annapolis, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-03981

MAP SHOWING HOW THE POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER OF SEPTEMBER 1979 DIFFERED FROM THE POTENTIOMETRIC SURFACE OF SEPTEMBER 1977, IN SOUTHERN MARYLAND,
Geological Survey, Annapolis, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-03983

GROUND-WATER HYDROLOGY OF THE MORMON ISLAND CRANE MEADOWS WILD-LIFE AREA, NEAR GRAND ISLAND, HALL COUNTY, NEBRASKA,
Geological Survey, Denver, CO. Water Resources Div.
R. T. Hurr.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $2.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-1109, 1981. 16 Fig, 5 Ref.

Descriptors: *Groundwater, *Surface-groundwater relations, *Streamflow, *Wildlife habitats, Wetlands, Surface water, Water management, Diversion, Irrigation, Data collections, *Nebraska, Platte River, Mormon Island Crane Meadows wildlife area. *Hall County.

The Platte River in south-central Nebraska flows generally eastward in a broad, flat valley. The

river banks and many areas adjacent to the river support thick stands of cottonwood and willow trees. Brush, grass, pasture land, and cultivated fields occupy most of the remaining area. This is the habitat for many types of wildlife that live in the area or stop over in the area during annual migrations. Both sandhill cranes and whooping cranes are part of the annual migration. There is concern that water-management changes, such as surface-water diversions or ground-water withdrawals for irrigation, may alter the hydrologic environment of the wetland areas and be harmful to the wildlife habitat. In order to determine what affect changes in water management might have on ground-water levels in the wetland areas, detailed data were collected from Crane Meadows Wildlife Area, which is on an island in the Platte River near Grand Island, Nebr. Ground-water levels beneath the island respond to changes in river stage, to recharge from snowmelt and precipitation, and to evapotranspiration by riparian vegetation and from areas where the water table is close to the land surface. The data show that ground-water levels respond rapidly to changes in river stage--usually within 24 hours for distances up to 2,500 feet from the edge of the river. Thus changes in river stage due to changes in surface-water diversions will not have a long-term effect on ground-water levels. Changes in ground-water withdrawals will have the double effect of changing ground-water levels due to changes in drawdown and due to changes in river stage caused by the effects of pumping on river flow. These effects will develop slowly and be long lasting. (USGS)
W82-03991

GROUND-WATER LEVELS IN SELECTED WELL FIELDS AND IN WEST-CENTRAL FLORIDA, MAY 1981,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-03992

RESULTS OF EXPLORATORY DRILLING AT POINT MACKENZIE, ALASKA, 1981,
Geological Survey, Anchorage, AK. Water Resources Div.
L. Patrick.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $1.25, Microfiche $3.25. Geological Survey Open-File Report 81-1072, 1981. 8 p, 2 Fig, 3 Tab, 1 Ref.

Descriptors: *Groundwater, *Test wells, *Aquifers, *Water quality, Exploration, Aquifer characteristics, Well logs, Water level fluctuations, Chemical analysis, Water quality standards, Saline water intrusion, *Alaska, *Point MacKenzie.

The Matanuska-Susitna Borough anticipates industrial development near Point MacKenzie, Alaska. Because little hydrologic information is available for the area, the Borough contracted for the drilling of two test wells. It was found that: Both wells penetrated unconsolidated stratified clay, silt, sand, and gravel; each well penetrated a shallow unconfined and deeper confined aquifers; the water levels in the wells rise and fall with the tide; the chemical analyses indicate that the water quality meets the Alaska Drinking Water Standards, except for slightly high levels of manganese and pH; and the potential for saltwater intrusion should be evaluated as part of future studies. (USGS)
W82-03993

GLACIATION AND GROUND WATER.
For primary bibliographic entry see Field 2C.
W82-04002

A HISTORICAL JEWELPIECE--DISCOVERY OF THE MILLENNIUM HYDROLOGICAL WORKS OF KARAJI,
Tehran Univ. (Iran). Dept. of Civil Engineering.
H. Pazwash, and G. Mavrigian.
Water Resources Bulletin, Vol 16, No 6, p 1094-1096, December, 1980. 14 Ref.

Descriptors: *Hydrology, *History, *Groundwater, Translations, Aquifers, Exploration, Phreatophtes, Karaji, *Iran, Bioindicators, Water conveyance.

The oldest manuscript on ground water science was written in Arabic about 1016 AD by the Persian scholar and Scientist, Mohammed ibn al-Hasan al-Hasib al-Karaji, sometimes referred to as Mohammed Karaji. The present authors emphasize the ancient scientist's full name and the proper translation of the title, 'The Extraction of Hidden Waters to the Surface,' rather than the common translation, 'Exploration for Hidden Water.' The ancient author was familiar with many of the hydrological concepts valid today: the hydrologic cycle, gravitational flow of water, water-bearing properties of different soils and rocks, phreatophytes, and types of aquifers (confined, unconfined, and perched). He also described instruments and devices used for surveying and construction of underground conduits. (Cassar-FRC)
W82-04155

GEOHYDROLOGIC APPRAISAL OF WATER RESOURCES OF THE SOUTH FORK, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04206

2G. Water In Soils

MEASUREMENT OF SORPTIVITY AND SOIL WATER DIFFUSIVITY IN THE FIELD,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
B. E. Clothier, and I. White.
Soil Science Society of America Journal, Vol 45, No 2, p 241-245, March/April, 1981. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Soil water, *Measurement techniques, Permeability coefficient, *Diffusivity, Infiltration, Hydraulic conductivity, *Soil types, Duffusion coefficient.

An analysis for scaling the exponential soil water diffusivity function from concurrent measurements of sorptivity and wet front advance is presented. This analysis provides a field method for measuring the slope of the exponential diffusivity function. Bungendore fine sand in the field was found to have a slope of the exponential diffusivity function equal to 3. Previous absorption experiments on a variety of repacked soils have consistently found the slope equal to 8 and have suggested that 8 may be a 'universal' value applicable to all soils. Although the exponential function with the slope of the exponential function equal to 3 provided a usable approximation over the entire range of water content, data from undisturbed cores showed that soil water diffusivity was effectively constant at high water contents and that the undisturbed data were well described by an exponential function with the slope equal to 8 for lower water contents. Measurements of sorptivity, wet front advance, and hydraulic conductivity were made in the field using a device that supplied water to the soil surface at the small tension of 4 centimeters. This technique gives the physical properties of the soil matrix, since larger channels and voids do not affect the measurements made at a small tension. Sorptivity of Bungendore fine sand is about 0.4 that from ponded infiltration affected by the macropores. (Carroll-FRC)
W82-03764

ANALYSIS OF THREE-DIMENSIONAL FLOWS INTO DRAINTILE,
Mississippi University, University Dept. of Civil Engineering.
S. N. Prasad, C. V. Alonso, and D. G. DeCoursey.
Journal of Hydrology, Vol 51, No 1-4, p 295-303, May, 1981. 3 Fig, 4 Ref.

Descriptors: *Tile drainage, *Flow characteristics, *Mathematical equations, Surface flow, Soil water, Agriculture, Drainage, *Soil water movement.

Three-dimensional potential flows into draintile, applicable to drainage problems in agriculture or foundation stability, were considered by focusing on surface flow into a single row of tiles embedded in the soil. The basic problem solved is that of non-axisymmetric flows from an external cylindrical surface to a series of equally spaced openings between cylindrical draintiles. Closed-form solutions of integral equations, which arise from satisfying mixed boundary conditions on the tile surfaces, are presented. Numerical results are reported for the special case of axisymmetric flows in which the effects of various parameters, such as radii of cylindrical surfaces and gap width, are shown explicitly. Since the existence of an inviscid flow condition is assumed, i.e., all the water that enters the drain moves on through, the results should be regarded as upper bounds of the delivery ratios to be expected under real fluid flow conditions. (Carroll-FRC)
W82-03803

MODELING THE EFFECTS OF CONSERVATION PRACTICES ON SOIL MOISTURE,
Minnesota Univ.-Duluth.
F. I. Idike.
PhD Thesis, June, 1981. 197 p, 13 Fig, 21 Tab, 150 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-25972.

Descriptors: *Model studies, *Soil water, Conservation, *Evapotranspiration, Computer models, Agriculture hydrology, Cropland, Corn, *Hydrologic budget, *Water conservation, Soil water balance, Minnesota.

A computer model of the soil water balance was developed. Included are submodels for surface storage, infiltration, soil-water redistribution and evapotranspiration. Soil water storage is modeled by 15.24 or 30.48 cm layers to a depth of 152 cm (5 ft). Moisture movement between layers (downward or upward) is calculated hourly or at two hour periods from soil moisture gradients between layers using Darcy's law for unsaturated flow in porous media. Soil moisture data under corn for a field location in southwestern Minnesota were analyzed for a period of nine years. One objective of this analysis was to determine the relationship of actual to potential evapotranspiration independent of crop stage. Soil moisture extraction from various depths was studied also and was related to crop stage. In the model, potential evapotranspiration is calculated daily by use of a pan model, with the pan coefficient varying as a function of crop stage. Potential evapotranspiration is adjusted to actual evapotranspiration (when appropriate) using one of the three curves. The moisture extracted (ET) is distributed between soil layers varying with the crop stage from a shallow depth at planting time to the entire profile at full growth. Infiltration is calculated by periods of one hour or less using a measured parameter model. (Sinha-OEIS)
W82-03811

KINEMATIC SUBSURFACE STORMFLOW,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
K. Beven.
Water Resources Research, Vol 17, No 5, p 1419-1424, October, 1981. 5 Fig, 1 Tab, 29 Ref.

Descriptors: *Storm seepage, *Model studies, Subsurface drainage, Mathematical models, Permeability, Soil porosity, *Soil properties, Groundwater, Mathematical studies, *Hydraulic conductivity.

The analysis of Henderson and Wooding, 1964, is expanded in comparing simplified models of subsurface stormflow for the case of a sloping soil mantle in which the hydraulic conductivity is constant throughout. Reviewing studies both in the field and theoretical in nature, the process of subsurface stormflow apparently will be the dominant mode of hydrological response of a hillslope or catchment under the following conditions: soils of high permeability, whether inherent in the soil matrix or due to structural or biotic macropores; and a steep hydraulic gradient, whether due to the slope of hillslopes or to the buildup of groundwater mounds on shallow slopes. The magnitude

and timing of the subsurface flow response will depend on the depth and hydraulic conditions of the unsaturated zone at the time of the storm. In this paper only the simplest possible conditions have been studied, with the unsaturated zone being neglected, and constant input to a soil of constant hydraulic conductivity and effective porosity throughout its depth being assumed. It has been shown using data from field and numerical studies of subsurface stormflow that the kinematic approximation may be appropriate for combinations of slope conditions and input rates of practical interest. (Baker-FRC)
W82-03844

MODELING THE TRANSPORT OF HEAT, WATER, AND SOLUTE IN UNSATURATED SOIL AND EARTH MATERIALS,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 5B.
W82-03958

INFLUENCE OF VEGETATION, ROCK COVER, AND TRAMPLING ON FILTRATION RATES AND SEDIMENT PRODUCTION,
Utah State Univ., Logan. Watershed Science Unit.
M. Dadkhah, and G. F. Gifford.
Water Resources Bulletin, Vol 16, No 6, p 979-986, December, 1980. 8 fig, 2 Tab, 17 Ref.

Descriptors: *Soil compaction, *Infiltration rate, *Vegetation effects, *Sediment yield, Grasses, Soil surfaces, Erosion control, Soil conservation, Range management, Grazing, Soil-water-plant relationships.

The influence of soil surface characteristics on infiltration rates and sediment production were studied in plywood boxes containing a loamy top soil. Treatments included two species of grass (crested wheatgrass and intermediate wheatgrass), three levels of grass cover (30, 50, and 80%), four levels of rock cover (5, 10, 15, and 20%) and six levels of simulation of trampling by animals (10 to 60% of surface area). The most important factor influencing infiltration rate was trampling, which accounted for 35-48% of variation. At trampling of 20% or greater the effects of vegetation cover and rock cover were insignificant. On untrampled soil infiltration rates increased as rock cover increased. Sod-forming grass allowed slightly more infiltration than bunchgrass. The most important factor in sediment production was grass cover, which was responsible for 40-61% of the variations in sediment yield. Rock cover had no effect on sediment production. Trampling tended to decrease the effectiveness of the grass cover. Under these conditions of soils and slopes a grass cover of 50% would be adequate to protect the soil from erosion. (Cassar-FRC)
W82-04153

LONG-TERM TILLAGE EFFECTS ON INTERROW RUNOFF AND INFILTRATION,
Science and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
M. J. Lindstrom, W. B. Voorhees, and G. W. Randall.
Soil Science Society of American Journal, Vol 45, No 5, p 945-948, 1981. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Infiltration, *Soil compaction, *Cultivation, *Runoff, Corn, Minnesota, Vegetation effects, Soil density, Erosion, *Agricultural hydrology, Rainfall-relationships, Furrows.

The effects of tillage systems and planting wheel traffic on interrow runoff and infiltration were measured after 10 years of continuous corn production using three tillage systems: conventional (fall moldboard plow with spring field cultivate), conservation (fall chisel with field cultivate), and no till. Simulated rainfall was applied at the rate of 12.7 cm per hour to wheel-tracked and nonwheel-tracked interrows in the southcentral Minnesota fields. The treatments, ranked according to rainfall kinetic energy required to start runoff, were: conservation and nonwheel-tracked interrow (NWT) > conventional and NWT > conventional and wheel-tracked interrow (WT) = conservation and WT > no till and NWT > no till and WT. The conservation and conventional nonwheel-tracked interrows had a greater infiltration rate after runoff started than the wheel-tracked interrows and the no till system. This study indicates that the no till system may produce a compacted soil surface with low infiltration capacity which is susceptible to large runoff volumes during severe rainstorms. Normal soil loosening processes (freezing-thawing, wetting-drying, and soil fauna) and the presence of vegetation residues have apparently not corrected this undesirable condition. (Cassar-FRC)
W82-04189

POSSIBLE USE OF ACTIVE MICROWAVE REMOTE SENSING DATA FOR PREDICTION OF REGIONAL EVAPORATION BY NUMERICAL SIMULATION OF SOIL WATER MOVEMENT IN THE UNSATURATED ZONE,
Centre de Recherches en Physique de l'Environement, Issy-les-Moulineaux (France).
R. Bernard, M. Vauclin, and D. Vidal-Madjar.
Water Resources Research, Vol 17, No 6, p 1603-1610, December, 1981. 8 Fig, 1 Tab, 29 Ref.

Descriptors: *Microwaves, *Evaporation, *Remote sensing, Radar, *Soil water movement, *Soil types, Evapotranspiration, Aeration zone, Model studies, Infiltration.

Bare soil evaporation was estimated from microwave radar data. The Richards equation to describe isothermal water movement in a nonswelling soil was solved numerically, using soil moisture values estimated from simulated radar data as the upper boundary condition. Two soils were used in the study, a light clay and a sandy loam. A sampling period of 3 days for the radar data was satisfactory for the clay soil, but a shorter sampling period was necessary for the sandy soil because of its higher hydraulic conductivity. Relationships are given for extending the local model to a regional scale using the similar media concept. (Cassar-FRC)
W82-04199

SEEPAGE FLOW INTO FLORIDA LAKES,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 2H.
W82-04241

2H. Lakes

CURRENT USE AND TECHNOLOGY OF LANDSAT MSS DATA FOR LAKE TROPHIC CLASSIFICATION,
North Carolina State Univ. at Raleigh.
For primary bibliographic entry see Field 7B.
W82-03755

BIOLOGICAL COLONIZATION OF AN INDUSTRIAL POND: STATUS AFTER TWO DECADES,
Battelle Pacific Northwest Labs., Richland, WA.
W. H. Rickard, R. E. Fitzner, and C. E. Cushing.
Environmental Conservation, Vol 8, No 3, p 241-247, Autumn, 1981. 7 Fig, 2 Tab, 16 Ref.

Descriptors: *Artificial lakes, *Ecosystems, Aquatic animals, Invertebrates, Ponds, Gable Mountain Pond, *Industrial wastes, Ponding, Radioisotopes, Effluents, Aquatic populations, Fate of pollutants, *Hanford Site, Washington, Cooling water, *Cooling ponds.

An isolated man-made pond was created in 1957 to receive used cooling water from the Department of Energy's Chemical processing facility at the Hanford Site. There is no permanently defined outlet from the pond; input is matched by percolation through the bottom and evaporation. The biological status of this pond after 20 years of existence is reported. The pond lies in the dry sagebrush region of south central Washington and is colonized by bulrushes, cattails, and numerous algae. The first vertebrate users of the pond were migratory waterfowl. Several duck species now nest there, making use of the shoreline plant communities and submerged macrophytes. Large mammals in the area of the pond include mule deer, coyotes and raccoons. Turtles and garter snakes are not present in this area, but are to be found in nearby Columbia and Vakuma Rivers. Lack of connecting surface waterways between the pond and the regional watercourses has prevented some species from traveling to the pond. The only fish present are goldfish. Low levels of industrially derived radionuclides, especially cesium-137, are found in the pond. Radiocesium is mostly confined to bottom sediments, but is readily assimilated by biota and so appears at all trophic levels. Uptake of radiocesium from sediments was investigated by periodic analysis of goldfish maintained in cages within the pond. Waterfowl could be deterred from nesting near the pond by destroying aquatic emergent plants. However, it is recommended that the natural biota of the pond be left intact to study the fate of radionuclides. (Baker-FRC)
W82-03772

COMMENT ON 'A RELATION BETWEEN LAKE MORPHOMETRY AND PRIMARY PRODUCTIVITY AND ITS USE IN INTERPRETING WHOLE-LAKE EUTROPHICATION EXPERIMENTS' (E.J. FEE),
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5C.
W82-03780

PARAMETER ESTIMATION IN EUTROPHICATION MODELLING,
International Society of Ecological Modelling, Copenhagen (Denmark).
S. E. Jorgensen, L. A. Jorgensen, L. Kamp-Nielsen, and H. F. Mejer.
Ecological Modelling, Vol 13, No 1/2, p 111-129, June, 1981. 3 Fig, 9 Tab, 7 Ref.

Descriptors: *Lakes, *Eutrophication, *Parameter estimation, Water pollution effects, Sampling, *Model studies, Phytoplankton, *Nutrients, Algae.

A method for estimating parameters for lake eutrophication models combines a program of 1 to 3 samples per month with intensive sampling in subsystems during periods of maximum changes. The method is applied to the Jorgensen (1976, 1978) model consisting of 17 state variables. Using bimonthly measurements, several solutions to the parameters are obtained, all offering the same validation, but produces a unique set of parameters. Some of the parameters (settling rate for Scenedesmus, minimum kg C per phytoplankton biomass, and maximum kg P per kg phytoplankton biomass) also get more realistic values. Under changed nutrient loadings, it may be important to use the unique set of parameters based on the intensive measurements. The method can also help select the best possible process description. In the case investigated the temperature expression and the Michaelis-Menton expression were found inadequate. (Cassar-FRC)
W82-03863

LABORATORY AND FIELD STUDIES OF THE RELATIVE MOBILITY OF 239, 240PU AND 241AM FROM LAKE SEDIMENTS UNDER OXIC AND ANOXIC CONDITIONS,
Argonne National Lab., IL. Radiological and Environmental Research Div.
For primary bibliographic entry see Field 5B.
W82-03899

THE UTILITY OF DIATOM ANALYSES OF LAKE SEDIMENTS FOR EVALUATING ACID PRECIPITATION EFFECTS ON DILUTE LAKES,
State Univ. of New York Coll. at Osewgo. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5C.
W82-03903

FACTORS AFFECTING MARL DEPOSITION IN KNOWLTON LAKE, SOUTHEASTERN ONTARIO,
Queen's Univ., Kingston (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2K.
W82-04031

PHOSPHORUS RECYCLING IN FIVE SHALLOW LAKES,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
H. G. Stefan, and M. J. Hanson.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 713-730, August, 1981. 15 Fig, 6 Tab, 11 Ref.

Descriptors: *Phosphorus, Lakes, *Lake sediments, Bottom sediments, Nutrients, *Algae, Sediments, *Phosphorus recycling, *Shallow lakes.

Evidence of phosphorus loading and recycling in a chain of five shallow lakes was collected during several years of study using the following three approaches: (1) mass balance method, involving measurement of in-lake phosphorus content at a given time and comparison with measured or computed antecedent phosphorus inflows; (2) source identification, involving intensive in-lake measurement of parameters relating to suspected release mechanisms; and (3) potential source verification, involving experimentation with sediments, water, and organisms from the lakes under lake conditions favorable to phosphorus release. The lakes, which serve a variety of water supply, cooling, and recreational needs for the city of Fairmont, Minnesota, have experienced excessive growth of blue-green algae for over 50 years. Data collected during this study prove that phosphorus is recycling from the sediments in this chain of shallow lakes. The events and processes which lead up to and accompany the phosphorus recycling have been captured in a variety of measurements in situ and in the laboratory. It is concluded from the evidence that phosphorus recycled from the sediments in these lakes is available in midsummer to support nuisance algae blooms. Lake restoration techniques must be selected which will respond to this observation. (Carroll-FRC)
W82-04040

LIMNOLOGY OF THE UPPER NORTH PLATTE RESERVOIR SYSTEM, WYOMING,
Bureau of Reclamation, Denver, CO.
J. J. Sartoris, J. F. LaBounty, S. G. Campbell, and J. R. Boehmke.
REC-ERC-81-10, July, 1981. 134 p, 36 Fig, 24 Tab, 53 Ref, 5 Append.

Descriptors: *Limnology, *Reservoir operation, *Environmental effects, Eutrophication, *Dam effects, *Reservoir releases, Salinity, Nutrients, Cyanophyta, Rrunoff, Primary productivity, *North Platte River, Alcova Reservoir, Pathfinder Reservoir, Kortes Reservoir, Semino Reservoir, *Wyoming.

The baseline limnology of Seminoe, Kortes, Pathfinder, and Alcova Reservoirs, on the North Platte River, was studied during 1976-79. The study period included two years of severe drought followed by two of higher than average runoff in the North Platte basin. The reservoirs differ greatly in volume and operating patterns: Seminoe is mainly for power production; Korte and Alcova, for flow regulation, and Pathfinder for storage. The three major system tributaries, the North Platte, Medicine Bow, and Sweetwater Rivers, differ significantly in chemical composition and annual flow volume. Limnology of the Upper North Platte reservoir system is typical in many ways of the High Plains Region; the reservoir waters are dimictic and alkaline, with salinity averaging 369 mg/1 and calcium carbonate hardness averaging 184 mg/1. Also the bluegreen alga, Aphanizomenon flos-aquae, blooms in late summer. Study results showed that this annual bloom depends on a shift from phosphorus-limiting conditions in early summer to more nitrogen-limiting conditions by late summer. Nutient dynamics, and hence primary production in the system, is heavily influenced by the interaction of three main factors: system operating criteria, annual runoff variations in the three major tributaries, and the presence of deep outlets in all four dams. (Moore-SRC)
W82-04067

ALGAE AS SOURCES OF TRIHALOMETHANE PRECURSORS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W82-04149

MINERAL DYNAMICS OF THE SUBMERSED MACROPHYTE, MYRIOPHYLLUM HETEROPHYLLUM, AND THE COMPETITIVE INTERACTIONS FOR NUTRIENTS BETWEEN M. HETEROPHYLLUM, PHYTOPLANKTON AND THE SEDIMENTS IN LITTORAL WATERS,
New Hampshire Univ., Durham. Dept of Botany.
For primary bibliographic entry see Field 5C.
W82-04162

ATTENUATION OF INCIDENT SOLAR RADIATION IN LAKE WATER,
Rissyo Women's Coll., Koshigaya (Japan). Dept. of Geography.
T. Arai.
Japanese Journal of Limnology, Vol 42, No 2, p 92-99, 1981. 7 Fig, 1 Tab, 12 Ref.

Descriptors: *Measuring instruments, *Solar raidation, *Lakes, *Light penetration, Secchi disks, Solarimeter, Irradiation, Limnology, Japan.

The attenuation of incident solar radiation without spectral separation was analyzed in lake water in terms of Secchi disk transparency and non-dimensional depth. The rate of attenuation was very rapid in the shallow part, but reached a quasistationary condition in the deep part. The non-dimensional extinction coefficient was extremely large near the surface, but was reduced to about 1.5 below the depth of 0.3 in a non-dimensional depth. Transparency can be regarded as the most important parameter related to the extinction of solar radiation in water. The dimensional form of the extinction coefficient can be evaluated from the present result. A more detailed analysis cannot be made at present due to the physical and bio-physical significance of Secchi disk transparency not having been clarified. Absorption of solar radiation in water has great significance for the heat balance of lakes and biological production therein. Since the measurement of irradiance or illuminance needs a specially designed instrument, which is not common in general limnological studies, the present results provide practical knowledge in the field of physical and biological limnology. (Baker-FRC)
W82-04180

PRIMARY PRODUCTION IN A EUTROPHIC ACID LAKE,
West Virginia Univ., Morgantown. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-04192

EFFECTS OF WATER DRAWDOWN ON THE FAUNA IN SMALL COLD WATER RESERVOIRS,
Colorado Div. of Wildlife, Fort Collins.
For primary bibliographic entry see Field 6G.
W82-04219

SEEPAGE FLOW INTO FLORIDA LAKES,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
C. R. Fellows, and P. L. Brezonik.
Water Resources Bulletin, Vol 16, No 4, p 635-641, August, 1980. 1 Fig, 6 Tab, 16 Ref.

Descriptors: *Seepage, *Lake beds, *Hydrologic budget, Rainfall, Lakes, Groundwater movement, Subsurface water, Shores, *Lake Conway, *Lake Apopka, *Florida.

Seepage meters were used to measure subsurface seepage flows into 2 Florida lakes. Seepage accounted for 17.5% and 2.0% of the total hydraulic inputs of Lake Conway and Lake Apopka, respectively. The ratio of shoreline length to surface area (Conway, 4.0 per km and Apopka, 0.3 per km) appeared to be related to the proportion of seepage. Seepage meters were installed on 3 transects perpendicular to shore in each lake. Most seepage flows were 4-30 liters per sq m per day. The total range was 0 to 113 liters per sq m per day. Most seepage occurred within 30 m of shore and decreased exponentially with distance from shore. Lake bottoms with steeper slopes had higher flows concentrated into a narrower zone. Rainfall was reflected in seepage rates, which increased to 2.4 times the prerain flow for an hour and returned to background levels within 6 hours. (Cassar-FRC)
W82-04241

EUTROPHICATION MEASURES FOR SMALL LAKE WATER QUALITY MANAGEMENT,
De Paul Univ., Chicago, IL. Dept. of Economics.
J. Ciecka, R. Fabian, and D. Merilatt.
Water Resources Bulletin, Vol 16, No 4, p 681-689, August, 1980. 2 Fig, 3 Tab, 12 Ref.

Descriptors: *Eutrophication, *Lakes, *Water quality management, Model studies, Trophic level, Nutrients, Phosphorus, Chlorophyll a, *Shallow lakes.

Statistical analysis of 195 small, shallow lakes showed that these fit Vollenweider and Dillon's model of the eutrophication process. Four factors, or dimensions, were identified which collectively accounted for 77% of the variance in original data. These factors were: (F1) lake size dimension, (F2) water-nutrient loading, (F3) water quality dimension, and (F4) nutrient stock dimension. Use of factor scores permitted lakes to be located on each dimension. F1 was poorly correlated with eutrophication. Non-eutrophic lakes were clustered on the F2 dimension. F3, defined by chlorophyll a concentration, P concentration, and secchi disc depth, was very successful in distinguishing eutrophic lakes from noneutrophic lakes. Lakes were so scattered on F4 that no interpretation was possible. Equations were developed to predict eutrophication level (chlorophyll a and secchi disc depth) from easily determined variables such as P loading and hydraulic loading. An alternative eutrophication index, based on the score of Factor F3, is proposed. (Cassar-FRC)
W82-04243

EFFECT OF FILTRATION PRESSURE ON ANALYSES FOR CHLOROPHYLL,
Geological Survey, Atlanta, GA.
B. W. Lium, and W. T. Shoaf.
Water Resources Bulletin, Vol 16, No 2, p 359-360, April, 1980. 1 Tab, 5 Ref.

Descriptors: *Chlorophyll, *Water analysis, *Filtration, Phytoplankton, Plankton, *Algae, Lakes, Analytical techniques, Comparison studies.

To determine the effect of filtration pressure on chlorophyll concentrations in algae containing water, eight lake samples with diverse mixtures and concentrations of phytoplanton and one laboratory grown culture were analyzed. The samples were filtered at five pressures, from 5 to 75 pounds per square inch using an inert compressed gas. The filtered samples were analyzed immediately after filtration, and nine different dominant organisms were found. Both green and blue green algae were represented in the samples. Diatoms were also represented, but were less dominant than the green and blue green algae. The constancy of the chlorophyll concentrations for each sample set clearly indicates that pressure of filtration has no effect on the measurement of chlorophyll a or b in the range of pressures tested. (Baker-FRC)
W82-04247

2I. Water In Plants

LEACHING REQUIREMENTS FOR SALINITY CONTROL. II. OAT, TOMATO, AND CAULIFLOWER,
Science and Education Administration, Riverside, CA. Salinity Lab.
J. A. Jobes, G. J. Hoffman, and J. D. Wood.
Agricultural Water Management, Vol 4, No 4, p 393-407, December, 1981. 6 Fig, 5 Tab, 8 Ref.

Descriptors: *Leaching, *Salinity, Chemical properties, *Crop yield, Oats, Tomatoes, Cauliflower, *Irrigation, Percolation, Saline soils, Research facilities, United States Salinity Laboratory, California.

The minimum leaching fraction that maintains full crop production, called the leaching requirement, was determined in field plots at the United States Salinity Laboratory for three crops: oat, tomato, and cauliflower. Leaching-fraction treatments were replicated several times by daily pulse irrigation with water having an electrical conductivity of 2.1 dS/m. All three crops were grown in rotation during 1977 and 1978, with a third tomato crop in 1979. The data clearly indicate that the leaching requirement for oat grain is about 0.10 for irrigation water of the quality used. For oat forage the leaching requirement is more than 0.17, as no yield plateau was found. Although oat yields were only about two-thirds of those for variety field trials near Riverside under nonsaline conditions, it is not expected that the relationship between relative yield and leaching requirements would be altered with higher yields. Evapotranspiration during each crop's growing season coincident with the leaching requirement was 390, 850, and 230 mm for oat, tomato, and cauliflower, respectively. (Baker-FRC)
W82-03790

A COMPARISON OF THE STRUCTURE, PRIMARY PRODUCTIVITY, AND TRANSPIRATION OF CYPRESS ECOSYSTEMS IN FLORIDA,
Florida Univ., Gainesville. Center for Wetlands.
S. Brown.
Ecological Monographs, Vol 51, No 4, p 403-427, December, 1981. 5 Fig, 17 Tab, 83 Ref.

Descriptors: *Nutrients, *Primary productivity, *Sewage disposal, Wetlands, Cypress, Phosphorus, Flood plains, Productivity, Water stress, Effluents, Biomass, Trees, Respiration, *Transpiration, Photosynthesis, *Florida, Litter, Soil-water-plant relationships, Comparison studies.

The effects of water and nutrients on cypress ecosystems were studied in a scrub cypress forest, natural and sewage enriched cypress domes, and a cypress flood plain forest. Water inputs ranged from stagnant to flowing. Phosphorus concentrations ranged from 0.01 g P per sq m per year in the scrub cypress forest to 1625 g P per sq m per year in the flood plain forest. The aboveground biomass (0.2504.78 g P per sq m) was positively correlated with P inputs. Biomass was related to stand history rather than P inputs. The following factors increased with increasing total P inputs: Net daytime photosynthesis (2.1-13.7 g C per sq m ground surface per day), plant respiration (0.9-10.9 g C per sq m ground surface per day), gross primary productivity, total water loss, and aboveground biomass production (sum of wood production, 44-1080 g per sq m per year, plus litterfall, 224-941 g per sq m per year). However. the last factor, aboveground biomass production, leveled off in the high P input range. Cypress in water limited areas had adapted to potential water stress through leaf morphology changes and minimum canopy development; these adaptations were not evident in flood plain cypress stands. The stand with added sewage effluent was higher than a similar untreated area in leaf biomass, leaf area index, and chlorophyll a and P levels stored in leaves. The net primary production, litter production, and wood production rates in sewage treated areas were about twice those of non-sewage treated areas. (Cassar-FRC)
W82-03885

PROTEIN AND FREE AMINO ACIDS IN FIELD-GROWN COWPEA SEEDS AS AFFECTED BY WATER STRESS AT VARIOUS GROWTH STAGES,
California Univ., Riverside. Dept. of Botany and Plant Sciences.
For primary bibliographic entry see Field 3F.
W82-04184

2J. Erosion and Sedimentation

PALEOFLOOD HYDROLOGY,
State Univ. of New York Coll. at Fredonia. Dept. of Geology.
For primary bibliographic entry see Field 2E.
W82-03761

RESERVOIR SEDIMENTATION MODELING,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
T. L. Rice.
PhD Thesis, 1981. 348 p, 57 Fig, 16 Tab, 287 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-26448.

Descriptors: *Model studies, Water storage, Reservoir storage, Sedimentation, *Sedimentation rates, *Reservoir silting, Reservoir operation, Data acquisition, Reservoir design, Computer models, Reservoir purpose, Model verification, John Martin Resrvoir, Colorado.

All reservoirs are destined to be filled with sediment. The rate at which the total storage space is depleted is only a portion of the problem. Since different elevations are allocated for different purposes (flood control, power production, irrigation, navigation, etc.), it is important for those charged with the responsibility of planning and regulating reservoirs to know how the trapped sediment will be distributed over the planned economic life. Thirteen separate physical processes are responsible for determining the distribution of sediment within a reservoir. These processes and their interactions are extremely complex and, thus, difficult to represent analytically in the reservoir environment. Reservoir circulation and settling by size fraction are most significant. Current data collection and reporting procedures are heterogeneous, uneconomical, and do not satisfy research needs. A general outline for a more systematic and intense data collection program is presented, which, if implemented, would serve to ameliorate the engineer's predictive capability. A computer model is developed which simulates the complex interactions of the dominant physical processes. Given the reservoir geometry (topographic survey), the water inflow versus outflow (reservoir operating rules), and expected sediment inflow, the model provides an approximation for both the amount of sediment entrapped and the location of that sediment within the reservoir for the period of analysis chosen. The model is verified using known input data from John Martin Reservoir - a semi-dry impoundment in southeast Colorado. (Sinha-OEIS)
W82-03813

RATES AND IMPLICATIONS OF BLUFF RECESSION ALONG THE LAKE MICHIGAN SHOREZONE OF MICHIGAN AND WISCONSIN,
Michigan State Univ., East Lansing. Dept. of Geography.
W. R. Buckler.
PhD Thesis, 1981. 225 p, 31 Fig, 14 Tab, 216 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No. GAX81-26477.

Descriptors: *Erosion, *Erosion rates, *Lake shores, Dunes, Shore protection, *Bluff recession, Michigan, Wisconsin, *Lake Michigan.

Long-term Lake Michigan bluff crest recession rates at 118 widespread locations in Michigan and Wisconsin are determined by contrasting recent fields measurements with those from 19th century government land office surveys. These rates are evaluated spatially and related to selected shorezone characteristics. Long-term recession data indicate that: (1) Sites and segments on both sides of Lake Michigan display wide variability in bluff line changes; (2) Bluff crest recession along opposite shores is statistically similar; (3) Non-sand dune bluffs along the southern shore of each state tend to experience relatively rapid retreat; and (4) Bluffs in southern Wisconsin recede at rates significantly higher than those in the north. Results of two case studies disclose that modern recession rates vary according to the interval between measurements. The highest rates tend to occur within periods that contain the greatest percentage of years when lake levels are high. Modern rates are not similar to long-term retreat values, a condition largely attributable to increasing numbers of shore protection structures that may accelerate bluff retreat in some places. (Sinha-OEIS)
W82-03817

DETERMINATION OF RECENT DEPOSITION RATES IN LAKE CONSTANCE WITH RADIOISOTOPIC METHODS.
Heidelberg Univ. (Germany, F. R.). Inst. for Sedimentology.
J. Dominik, A. Mangini, and G. Muller.
Sedimentology, Vol 28, No 5, p 653-677, October, 1981. 10 Fig, 11 Tab, 54 Ref.

Descriptors: *Sedimentation rates, *Radioisotopes, *Lead radioisotopes, Deposition, Lead, Zinc, *Lake Constance, Radioactive dating, Dating, Cesium radioisotopes, Heavy metals, Metals, Fate of pollutants, Lakes, Nutrients, Sedimentology, West Germany.

Eight sediment cores from Lake Constance were examined by alternative models of Pb210 dating and other radioisotopic time markers. Cores were grouped into three areas: central (deepest part of the lake), eastern, and Konstanzer Trichter. The sediment accumulation rates determined by the Pb210 method agreed well with sedimentological observations. Rates of deposition in the main basin varied from 0.06 sq cm per year in the central part to 0.13 sq cm per year in the eastern part and increased rapidly toward the Rhine delta. The rate of deposition has been constant since 1900 in the central part but has been increasing since 1955 in the Konstanzer Trichter area because of eutrophication and high carbonate production. The Cs137 dating method was fairly accurate for sediments deposited rapidly but was not reliable for slowly accumulating sediments (1 mm per year). The flux of Pb210 excess into sediments of the main basin followed the distribution pattern of solids. Recent nutrient and heavy metal fluxes for Lake Constance were as follows: central and Konstanzer Trichter area--55-58 micrograms P per sq cm per year, 198-212 micrograms N per sq cm per year, and 1.7 mg C per sq cm per year. Values for the eastern lake area were 153 micrograms P per sq cm per year and 483 micrograms N per sq cm per year. Anthropogenic fluxes of metals afer 1960 into the sediments were 10.2-31.3 micrograms Zn per sq per year and 2.8-5.9 micrograms Pb per sq cm per year, and for 1900-1920, 12.7-13.2 micrograms Zn per sq cm per year and 2.8-2.9 micrograms Pb per sq cm per year. These values are on the same order as those for other polluted lakes in Europe and America. (Cassar-FRC)
W82-03883

DELIVERY OF SUSPENDED SEDIMENT AND POLLUTANTS FROM NONPOINT SOURCES DURING OVERLAND FLOW,
Marquette Univ., Milwaukee, WI. Dept. of Civil Engineering.
V. Novotny.
Water Resources Bulletin, Vol 16, No 6, p 1057-1065, December, 1980. 7 Fig, 1 Tab, 23 Ref.

Descriptors: *Sediment transport, *Nonpoint pollution sources, *Overland flow, *Path of pollutants, Erosion, Sediment yield, Suspended sediment, Rainfall-runoff relationships, Runoff, Storm runoff, Model studies, Hydrographs.

The difference between estimated upland erosion and sediment yield is a result of reduction in sediment carrying capacity of the overland flow as rain ends. The sediment concentration of the flow

is related to the energy of the rain drops. During a storm the sediment concentration can reach 100,000 mg per liter on bare soil. When the rain ends, the energy level quickly drops and sediment settles out. This hypothesis was verified with field measurements in a 9.7 ha disturbed watershed in Wisconsin. Theoretical and measured sediment histograms agreed quite well. (Cassar-FRC)
W82-03902

INVESTIGATION OF FLUVIAL PROCESSES UNDER CONDITIONS OF NATURAL VARIABILITY OF THE RUNOFF,
N. S. Znamenskaya.
Water Resources (English Translation), Vol 8, No 1, p 29-39, January/February, 1981. 6 Fig, 2 Tab, 12 Ref. Translated from Vodnye Resursy, No 1, p 89-101, January/February, 1980 (SIC).

Descriptors: *Channel morphology, *Silting, *Runoff volume, Rivers, *Ob River, *USSR, Sediment transport, Dunes, Meanders.

The relation between volume of discharge and channel deformations was investigated in a straight stretch of the Ob River channel near the Barnaul city water intake. In this reach, which is in the third stage of development of incomplete meandering, dunes move intensely and threaten the intake. Generally, two types of channel deformation were observed: active (migration of dunes) and passive (migration of bars). In years when active deformations occur, passive deformations do not, and vice versa. The greater the volume of runoff exceeding a certain maximum probability, the greater the distance the dune migrates. The volume of sediment discharge corresponding to given structural deformations depends on the volume of runoff in a certain part of the hydrograph. A method is proposed for assessing the channel deformations from runoff volume. (Cassar-FRC)
W82-03906

RATES OF RECENT SEDIMENTATION IN LAKE PEPIN,
Science and Education Administration, Oxford, MS.
J. R. McHenry, J. C. Ritchie, and C. M. Cooper.
Water Resources Bulletin, Vol 16, No 6, p 1049-1056, December, 1980. 6 Fig, 2 Tab, 6 Ref.

Descriptors: Lake sediments, *Sedimentation rates, Lakes, *Lake Pepin, Tracking techniques, Tracers, *Minnesota, *Radioactive tracers, *Cesium radioisotopes.

Sedimentation rates in Lake Pepin, Minnesota, were determined from the Cs137 content of sediment cores. These rates have changed very little since 1895. Uncorrected for consolidation, the rates were 1.1-3.4 cm per year in 1895-1954, up to 3.0 cm per year in 1954-1964, and up to 3.5 cm per year in 1964-1977. The density of sediments increased with depth from 1.1-1.2 g per ml at the surface to 1.4-1.5 g per ml at 2 or 3 m depth. Although the more recent sedimentation rates are probably less than those of 50 years ago, they are large enough to allow conversion of the upstream portion of the lake into a marsh within a century. (Cassar-FRC)
W82-03922

LEAD-210 ANALYSES OF SEDIMENT ACCUMULATION RATES IN FIVE SOUTHERN ILLINOIS SURFACE MINE LAKES,
Illinois Univ. at Urbana-Champaign. Water Resources Center.
R. B. Brugam, and M. A. Carlson.
In: The Proceedings of the 1981 Symposium on Surface Mining Hydrology, Sedimentology, and Reclamation, p 195-200. University of Kentucky, Lexington. College of Engineering. B-138-ILL. USDI 14-34-0001-1220.

Descriptors: *Lead-210, *Sedimentation rates, Mine reclamation, *Lakes, Coal mining, Surface mining, Lake sediments, *Illinois, *Strip mine wastes, Strip mine lakes.

210Pb is a naturally occurring radionuclide with a short half-life (22 yrs) which can be used to determine sedimentation rates in lakes. The technique was applied in 5 southern Illinois surface mine lakes where it revealed past sedimentation rates to have been extremely variable. In some of the lakes there was evidence for extensive slumping immediately after mining ceased followed by a more regular sedimentary regime that continued until the present. In others, there have been one or more changes in sediment accumulation rates since lacustrine sedimentation began. These results suggest that simply measuring the amount of sediment that has accumulated in a surface mine lake since mining ceased is inadequate to determine filling rates. Sedimentation rates in the 5 lakes varied from .60 + to .19 to 1.46 + .19 cm/yr. These rates are similar to natural lakes with moderately disturbed watersheds.
W82-03960

THE ENTRAINMENT AND DEPOSITION OF FINE-GRAINED SEDIMENTS IN LAKE ERIE,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
D. Y. Lee, W. Lick, and S. W. Kang.
Journal of Great Lakes Research, Vol 7, No 3, p 224-233, 1981. 13 Fig, 1 Tab, 20 Ref.

Descriptors: *Sediment transport, Deposition, *Entrainment, Flumes, *Lake Erie, Lakes, Particle size, Shear stress, Turbulent flow, *Sediment distribution, Sediment-water interfaces, *Sedimentation rates.

Four sediment samples from western Lake Erie were analyzed in flumes to study entrainment and deposition. Turbulent flow produced at the top of the flume exerted a turbulent shear stress on the sediment-water interface at the bottom of the flume. Large variations in entrainment and deposition rates occurred. These depended on shear stress, water content (decreases with time after deposition), type of sediment (grain size and mineralogy), and manner of deposition. Entrainment rates were influenced by the method of preparing the sediments. If a thin surface layer of fine sediment was present, the entire layer tended to detach from the coarser sediment below. If the surface layer consisted of well-mixed particles of different sizes, individual particles were removed. (Cassar-FRC)
W82-04033

GEOMETRY OF GRAVEL STREAMS,
San Diego State Univ., CA.
For primary bibliographic entry see Field 2E.
W82-04113

INFLUENCE OF VEGETATION, ROCK COVER, AND TRAMPLING ON FILTRATION RATES AND SEDIMENT PRODUCTION,
Utah State Univ., Logan. Watershed Science Unit.
For primary bibliographic entry see Field 2G.
W82-04153

THE NORTH CAROLINA SEDIMENTATION CONTROL PROGRAM--AN ASSESSMENT,
North Carolina Water Resources Research Inst., Chapel Hill.
D. H. Howells, and H. K. Britt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-202102, Price codes: A04 in paper copy, A01 in microfiche. Report July, 1981. 56 p, 5 Tab, 27 Fig, 14 Ref, 1 Append. A-999-NC(55).

Descriptors: *Erosion control, *Sedimentation, Construction, Assessments, Soil conservation, Storm water, Storm runoff, Barriers, Legal aspects, Sanitary landfills, North Carolina.

The history, legislation, and experience associated with a state-wide program for the control of erosion and sedimentation from urban, highway, utility, and government land-disturbing activities are received. The initial principles of prevention, local involvement, flexibility, and acceptance continue to guide the program. Continued high public acceptance is reported. Work loads at state and local levels are cited. A review of technology includes: stormwater management; ground cover; channel alterations; temporary structures and drains; sediment basins; and silt check barriers, fences, and dams. The importance of considering erosion and sedimentation control in project planning and design is emphasized and illustrated. Available data on sedimentation control costs are given. Education programs and enforcement experience are examined. Conclusions and recommendations provide guidance for strengthening the program in the years ahead.
W82-04160

NEW EVIDENCE OF SCROLL-BAR FORMATION ON THE BEATTON RIVER,
Wollongong Univ. (Australia). Dept. of Geography.
G. C. Nanson.
Sedimentology, Vol 28, No 6, p 889-891, December, 1981. 1 Fig, 8 Ref.

Descriptors: *Sedimentation, *River beds, *Bed load, Meanders, Trees, *Beatton River, *British Columbia, Erosion, Sediment distribution, Channels, Detritus, Scroll bars.

In a previous publication by the same author two hypotheses were proposed to explain the formation of distinct scroll bars and subsequent flood plain ridges on the meandering Beatton River, British Columbia. These were: (1) separate zones might control sediment deposition against the convex bank and (2) the bimodal size range of the bed load might result in preferential deposition of a ridge of coarse sediment near the convex bank. Observations of scroll bars in early stages of development suggested a third hypothesis--that a scroll bar may begin to form around a snagged dead tree that acts as a sedimentation nucleus on a point-bar platform. (Cassar-FRC)
W82-04188

VISCOSITY-CONTROLLED SEDIMENT TRANSPORT IN THE ABSENCE OF SUSPENDED LOAD,
California Univ., Berkeley. Dept. of Engineering.
L. Ayala.
PhD Thesis, December, 1980. 262 p, 55 Fig, 4 Tab, 91 Ref, 2 Append. University Microfilms International, Ann arbor MI; Order No GAX81-12954.

Descriptors: *Sediment transport, *Suspended load, *Viscosity, Mathematical models, Alluvium, Alluvial flows.

When viscous forces are predominant near the bed, the mechanics of sediment removal and transport are mainly conditioned by the action of such forces. The phenomenon has practical implications in the physical modeling of alluvial flows and in the management of water resources, as when water allocations must be provided for navigation purposes in fine-sediment bed streams where bed form roughness and stages are drastically affected by water temperature variations. The goal of this investigation was to study experimentally, under constant energy slope and discharge conditions, the behavior of viscosity-controlled alluvial flows. Viscous effects were investigated by analyzing the influence of the fluid viscosity on bulk flow and sediment transport parameters including hydraulic relations, bedload rates, bed configurations and bedform geometrical properties. Two distinct types of viscosity-controlled alluvial flows were identified. The response of these flows to viscosity changes is opposite. The experimental findings, together with the bursting phenomenon concepts introduced in this study, were summarized in a conceptual model that aids in the physical explanation of some of the relevant features of viscosity-controlled sediment transport mechanics. (Sinha-OEIS)
W82-04210

EFFECTS OF A NORTH CENTRAL WASHINGTON WILDFIRE ON RUNOFF AND SEDIMENT PRODUCTION,
Pacific Northwest Forest and Range Experiment Station, Wenatchee, WA.
For primary bibliographic entry see Field 2E.
W82-04250

2K. Chemical Processes

THE IONIZATION OF ACIDS IN ESTUARINE WATERS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
F. J. Millero.
Geochimica et Cosmochimica Acta, Vol 45, No 11, p 2085-2089, November, 1981. 2 Fig, 3 Tab, 38 Ref.

Descriptors: *Saline water, *Ionization, *Acids, Estuarine environment, Seawater, Dissociation constant, Chemical properties.

Reliable estimates for the dissociation constants of most weak acids in estuarine waters can be determined by an equation presented in this paper. Good agreement between calculated and measured values of the thermodynamic constant in water, K sub HA, was obtained for the weak acids, ammonium, bisulfate, HF, water, B(OH)3, carbonic acid, bicarbonate, phosphoric acid, H2P04(-), H3As04, H2As04(-), and HAs04(--). Of the systems studied, only the HP04(--) value was not in agreement. This discrepancy is caused by interactions between Ca(+ +) and phosphate. (Cassar-FRC)
W82-03769

DISSOLUTION OF TETRAGONAL FERROUS SULFIDE (MACKINAWITE) IN ANOXIC AQUEOUS SYSTEMS. 2. IMPLICATIONS FOR THE CYCLING OF IRON, SULFUR, AND TRACE METALS,
California Inst. of Tech., Pasadena. Dept. of Environmental Engineering Science.
J. F. Pankow, and J. J. Morgan.
Environmental Science and Technology, Vol 14, No 2, p 183-186, February, 1980. 2 Fig, 12 Ref.

Descriptors: *Sulfides, *Iron compounds, Iron, Sulfur, Trace metals, Dissolved solids, Sediments, Mathematical models, Suspended solids, *Oxidation, Mathematical equations, *Chemical reactions, *Anaerobic conditions, Sludge.

Both oxidative and nonoxidative mechanisms can play important roles in determining how mackinawite (FeS) and associated trace metals are solubilized under different environmental conditions. Models are presented for determining the FeS concentration profiles in anoxic sediments experiencing FeS dissolution. Nonoxidative dissolution of sulfide phases may occur in such environments as anaerobic sewage sludges and anoxic sediments, as well as in the anoxic waters which may lie above these sediments. Oxidative dissolution is expected when anaerobic sewage sludge is discharged to oxic receiving waters and when oxygen penetrates anoxic sediments containing FeS. The relative proportions of FeS that dissolve oxidatively and nonoxidatively will depend upon such variables as oxygen flux rates, reduced carbon content, and porosity. The propotion of FeS that becomes pyritized will depend on the amount of elemental sulfur available for reaction within the body of anoxic sediments, as well as on how well the conversion of the FeS to pyrite (FeS2) can compete with oxidative dissolution at the oxic front. If anaerobic sewage sludge is discharged to anoxic waters, the nonoxidative dissolution rate will be very important in determining the lifetime of an FeS particle suspended in the anoxic waters. Nonoxidative dissolution experiments using copper have indicated that low parts per million levels of Cu(II) can substantially reduce the nonoxidative dissolution rate. (Carroll-FRC)
W82-03771

SALT MOVEMENT, LEACHING EFFICIENCY, AND LEACHING REQUIREMENT,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
J. W. Van Hoorn.
Agricultural Water Management, Vol 4, No 4, p 409-428, December, 1981. 13 Fig, 6 Tab, 16 Ref.

Descriptors: *Leaching, *Irrigation, Available water, Soil water, *Saline soils, Path of pollutants, Infiltration, Percolation, Leachates, *Salts.

To simulate salt movement under field conditions, experiments covering a period of several years were conducted in large tanks. The results were analyzed according to the plate model theory and by introducing a leaching efficiency coefficient to express the incomplete mixing of leaching water and soil water. Values obtained for the theoretical plate thickness and the leaching efficiency coefficient were compared with those derived from field experiments. The leaching requirement for salinity control based on a one-layer root zone with uniform salt distribution and complete mixing was compared with that based on a root zone built up as a series of layers with incomplete mixing. The standard deviation of the chloride concentration at each depth was small at the beginning of the percolation process when the soil was uniformly non-saline or highly saline; it increased strongly during the process, returning to its original value at the end. This suggests a very heterogeneous water and salt movement through the soil profile. Chloride concentration showed a large scattering. The effective mixing length in the tank was greater than in laboratory soil columns. Irrigation water and soil moisture did not mix completely. An increasing part of the irrigation water moved through the soil without contributing to the leaching process. The results of the tank experiments agree with those of field experiments on similar soils. (Baker-FRC)
W82-03791

CHEMICAL AND HYDROLOGICAL HETEROGENEITY OF GROUNDWATERS IN THE UPPER 'JURA NEUCHATELOIS', SWITZERLAND. (HETEROGENEITE CHIMIQUE ET HYDROLOGIQUE DES EAUX SOUTERRAINES D'UN KARST DU HAUT-JURA NEUCHATELOIS, SUISSE),
Neuchatel Univ. (Switzerland). Inst. de Geologie.
Y. Bouyer, and B. Kubler.
Journal of Hydrology, Vol 54, No 1-3, p 315-339, December, 1981. 11 Fig, 6 Tab, 27 Ref.

Descriptors: *Groundwater, *Chemical composition, Limestone, Bogs, Flow, Precipitation, *Karst hydrology, Karst, Sinks, Geochemistry, *Switzerland.

Water was sampled in a valley of the folded Jura Mountains at three different points and subjected to chemical analysis. Sampling points included the surface, sampled as running water; four boreholes in the karstic zone; and a karstic spring which collects the running surface water in boreholes. Factor analysis was used to treat the chemical parameters according to Benzecri, by comparing them with flow and precipitation. The results of the study, after occasional blind sampling and data treatment, show the individuality of the chemical composition of each borehole and the relationship between the surface flow and karstic springs. The linear correlation coefficients have confirmed the difference between the boreholes and distinguished the relationship between chemical component, flow and precipitation. The success of these comparisons is due to the particular type of water in this specific syncline of the folded Jura, where the highly-acid running water, drained from bogs, changes to hard water when it passes through the underlying limestone. The importance of the soil for the chemical composition of the groundwater is underlined. (Baker-FRC)
W82-03794

FLOW-SYSTEM CONTROLS OF THE CHEMICAL EVOLUTION OF GROUNDWATER,
Alberta Univ., Edmonton. Dept. of Geology.
F. W. Schwartz, K. Muehlenbachs, and D. W. Chorley.
Journal of Hydrology, Vol 54, No 1-3, p 225-243, December, 1981. 11 Fig, 16 Ref.

Descriptors: *Groundwater, *Chemical analysis, Water analysis, Sodium, Calcium, Oxygen, Deuterium, Sedimentary basins, Basins, Sedimentation, Sediment transport, *Solute transport, Flow, Flow pattern, *Canada, *Groundwater movement.

Since the early 1960's extensive studies have been made of the patterns of flow and chemical evolution of groundwater in the western Canada sedimentary basin. This paper describes the features of the hydrogeologic settings and geochemistry of units in the upper 1500 meters of the sedimentary basin and explains how features of the flow systems within the basin can exert a control on the isotope and major ion chemistry of the groundwater system. Isotopic and major ion analyses were made of 130 fresh and brackish groundwater samples. These reveal a strikingly consistent pattern of variation over 28,000 square kilometers of western Canada sedimentary basin. Hydrodynamic interpretations suggest a pattern of broad, regional flow from south to north. An influence of Wisconsin glaciation is suggested. All the permeable units appear to be recharged by meteoric water in the south, where they outcrop or come close to the surface. Samples of groundwater are progressively enriched in D, O18, sodium and calcium ions in each of six major sandstone units. The deepest waters of the artesian Milk River aquifer are enriched by up to 71% and 15% with respect to total D and total O18 of the modern recharge waters. Chemical evolution is strongly related to the hydraulic characteristics of the individual units. The isotopic composition is determined by the extent to which hydraulic conductivity has facilitated meteoric water flushing of connate water. Therefore, more permeable units and permeable zones within a unit tend to be isotopically lighter due to a more complete and rapid invasion of meteoric water. The largest conductivity values are found in some of the deepest units. The major-ion chemistry is controlled by both this process and a complex set of rock-water interactions. (Baker-FRC)
W82-03795

GEOCHEMICAL INPUTS FOR HYDROLOGICAL MODELS OF DEEP-LYING SEDIMENTARY UNITS: LOSS OF MINERAL HYDRATION WATER,
Illinois Univ., Urbana-Champaign. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-03796

THE RATE OF FLUSHING AS A MAJOR FACTOR IN DETERMINING THE CHEMISTRY OF WATER IN FOSSIL AQUIFERS IN SOUTHERN ISRAEL,
Ben-Gurion Univ. of the Negva, Beersheba (Israel). Inst. for Desert Research.
A. Issar.
Journal of Hydrology, Vol 54, No 1-3, p 285-296, 1981. 5 Fig, 12 Ref.

Descriptors: *Groundwater, *Chemical analysis, Water analysis, Aquifers, *Israel, *Aquifer characteristics, Flushing, Flow rates, Sandstones, Salinity, *Geochemistry, *Geohydrology, Saline water.

As attempt is made to describe processes by which the salinity of formation water has become lower over time. The deepest known brines in southern Israel and the Sinai were chosen for examination; the assumption is made that these brines contain formation water of marine origin before being diluted with meteoric water. The history of the inflow, flushing and mixing which occurred in these aquifers is described as follows. All aquifers were saturated by saline water or formation water. The inflow of meteoric water into the aquifers saturated by the formation water was made possible only when an outlet was formed for the formation water to be pushed out. This may have started in the Neogene, when transversal faulting occurred, but it certainly took place during the Pleistocene, after the down-faulting of the Syrian-African rift system. The inflow occurred by a piston action which started mainly through the sandstone outcrops in the central Sinai, but some inflow may have occurred in the sandstone outcrops in the northern Sinai and central Negev regions. As the piston acted on all of the layers, upwelling of saline water along major fault lines and unconformities could have occurred, which caused mixture processes in spite of the piston action. Another process of mixture occurred when the piston action in the south also caused formation water in the northern Negev to flow toward the Dead Sea rift. (Baker-FRC)
W82-03799

CHEMICAL EVOLUTION OF GROUNDWATER IN A DRAINAGE BASIN OF HOLOCENE AGE, EAST-CENTRAL ALBERTA, CANADA,

Alberta Research Council of Alberta Edmonton. Groundwater Div.
E. I. Wallick.

Journal of Hydrology, Vol 54, No 1-3, p 245-283, December, 1981. 21 Fig, 5 Tab, 40 Ref.

Descriptors: *Groundwater, *Chemical analysis, Model studies, Chemical reaction, *Groundwater movement, Chemical properties, Calcium, Drainage basins, Basins, Drainage, *Alberta, Sedimentation, Canada, *Geochemistry, Geohydrology.

An attempt is made to understand the chemical evolution of groundwater in a prairie setting that is a strip-mine analogue by considering chemical weathering reactions involving organic matter, common carbonate and silicate minerals, and transport of weathering products in groundwater flow systems. The mean daily temperature of the study region ranges from -15 degrees to plus 18 degrees C. Potential evapotranspiration of about 530 mm/year is noted, which greatly exceeds the mean annual precipitation of 373 mm/year. The area has a cold semi-arid continental climate. The area is underlain by bedrock of Late Cretaceous age, which is overlain by glacial till and surficial deposits. The primary minerals of the Belly River Formation include volcanic glass, plagioclase crystals of oligoclase-andesine composition, quartz, feldspar, biotite, and organic compounds containing hydrogen, carbon, sulfur and nitrogen, associated with coal and clayshale. Secondary minerals include calcite, siderite, pyrite, montmorillonite, illite, kaolinite, chlorite and cristobalite. Two sources of carbon are noted in the groundwaters: the carbon dioxide present in the soil atmosphere derived from plant root respiration and decay, and the carbon dioxide resulting from oxidation of organic matter in the unsaturated zone and in the zone of fluctuating water table. Two possible sources of sulfur in the groundwater include sulfate derived from oxidation of sulfide compounds in the drift that were derived from the Belly River Formation. A mixing-model approach used the program MIX2 to explain the range in chemical composition of the groundwater. (Baker-FRC)
W82-03800

GROUND WATER CHEMISTRY AND HYDROCHEMICAL FACIES DISTRIBUTION AS RELATED TO FLOW IN THE MISSISSIPPIAN CARBONATES, HARRISON COUNTY, INDIANA,

Indiana Univ. at Bloomington. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-03810

DESCRIPTION OF SOIL CHEMISTRY DURING TRANSIENT SOLUTE TRANSPORT,

Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
L. M. Dudley, R. J. Wagenet, and J. J. Jurinak.
Water Resources Research, Vol 17, No 5, p 1498-1504, October, 1981. 4 Fig, 5 Tab, 16 Ref.

Descriptors: *Solute transport, *Irrigation effects, *Soil chemistry, Fate of pollutants, Conductivity, Lime, Gypsum, Model studies, Soil water, Case studies, *Utah.

A soil chemistry-solute model, SALTFLO, was tested in six Utah field plots containing lime and gypsum to determine its ability to predict soil solute concentrations. Treatment consisted of different combinations of five water qualities (gypsum, chloride, high gypsum, high chloride, and tap water) varying in electrical conductivity from 1.48 to 18.30 mmho per cm, and three water flux regimes (steady state, transient state, and flow under cropped conditions). The model includes descriptions of the precipitation and dissolution of both lime and gypsum and considers cation exchange. The model gave good predictions of soil solution electrical conductivity under cropped conditions but did not accurately simulate solute concentrations in noncropped cases. (Cassar-FRC)
W82-03840

ISOTOPIC AND GEOLOGIC STUDIES TO IDENTIFY THE SOURCES OF SULFATE IN GROUNDWATER CONTAINING HIGH BARIUM CONCENTRATIONS,

Illinois State Geological Survey Div., Champaign.
R. H. Gilkeson, E. G. Perry, and K. Cartwright.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-198037, Price codes: A03 in paper copy, A01 in microfiche. Research Report No 165, October, 1981. 39 p, 8 Fig, 3 Tab, 38 Ref. OWRT-A-100-ILL(1). 14-31-0001-9015.

Descriptors: Aquifer properties, Barite, *Barium, Chemical properties, Evaporite minerals, Glacial events, *Groundwater, Microbial reactions, Sedimentary rocks, Stable isotopes, *Sulfate, *Geochemistry.

Dissolved barium in excess of the USEPA drinking water standard occurs in groundwater of a region of the Cambrian-Ordovician aquifer system in northeastern Illinois that is anomalously depleted in dissolved sulfate. The concentration of dissolved sulfate is an important control on the dissolved barium concentration because of the low solubility of the mineral barite (barium sulfate). The depletion of dissolved sulfate is believed to be due to bacterially mediated sulfate reduction occurring in zones of anaerobic conditions. Isotopic analyses determined that oxidation of sulfide minerals is the primary source for dissolved sulfate in groundwater in the unconfined region of the flow system and that dissolution of evaporite minerals is the primary source for dissolved sulfate present in mineralized groundwater in the confined region of the flow system. The source of the evaporite minerals is problematic. Evaporites are not known to be present in the flow system and isotopic analyses provided evidence that the dissolved sulfate was derived from evaporites of a different age than could occur in the Cambrian and Ordovician strata of the aquifer system. The depletion of O in groundwater in confined regions of the flow system is interpreted as evidence of the importance of glacial processes to recharge of the groundwater. Dissolved sulfate from marine evaporites of a younger geologic age may have been recharged to the flow system as a result of glacial processes.
W82-03931

MAP SHOWING GENERAL CHEMICAL QUALITY OF GROUND WATER IN THE RICHFIELD QUADRANGLE, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-03977

FACTORS AFFECTING MARL DEPOSITION IN KNOWLTON LAKE, SOUTHEASTERN ONTARIO,

Queen's Univ., Kingston (Ontario). Dept. of Geography.
R. Gilbert, and S. M. Leask.
Journal of Great Lakes Research, Vol 7, No 3, p 286-289, 1981. 3 Fig, 15 Ref.

Descriptors: *Chemical precipitation, *Saturation index, *Marl, Lakes, Lake sediments, Macrophytes, Thermal stratification, Stratification, Organic matter, Gyttja, *Knowlton Lake, *Ontario, Calcium carbonate, Sedimentation.

Dimictic Knowlton Lake, Southeastern Ontario, exhibits two distinct sedimentary environments: marl benches up to 5 meters thick containing 75-95% calcium carbonate in the shallow water less than 15 meters deep and organic rich (55%-60%) gyppja 5-7 meters thick. The thermal structure of this 1.82 sq km lake is responsible for the sediment pattern. Calcium carbonate saturation in the epilimnion is established with thermal stratification in May and continues to increase to saturation index values of > 2.5 throughout the summer. The second and higher peak in saturation index occurs in September just before the fall overturn, a result of increased macrophyte production, carbon dioxide reduction, and high temperatures. The hypolimnion remains undersaturated (generally < 0.2) throughout the year. (Cassar-FRC)
W82-04031

CHEMICAL SPECIES DISSOLVED IN SHALLOW GROUNDWATERS OF THE PLAINS AROUND ROKKO MOUNTAINS, (IN JAPANESE),

Konan Univ., Kobe (Japan). Faculty of Science.
Y. Kusaka, H. Truji, Y. Fujimoto, K. Ishida, and Y. Fukui.
Japanese Journal of Limnology, Vol 42, No 2, p 65-71, 1981. 6 Fig, 3 Tab, 7 Ref. (English Summary).

Descriptors: *Groundwater, *Chemical analysis, Wells, Calcium, Magnesium, Sodium, *Wells, Aquifers, Carbonates, Chlorides, Sulfates, Silicates, Phosphates, Vanadium, *Geohydrology, Chemical reactions, *Japan.

Water samples were taken from 17 wells of Mikage, Uozaki and Nishinomiya districts in the southern alluvial plain and from 39 wells of Arino, Yokawa and Ohgo districts in the northwestern Neogen hillside. The correlations between water quality and geological features are considered. Major components such as calcium, magnesium, sodium, carbonate, chlorides, sulfates, and silicates are present in each district, whereas the minor components such as phosphates, boron oxides and vanadium are relatively high in the Nishinomiya district. In the Neogene area the concentrations of the major components are widely varied in each well, and the sodium content is somewhat on the high side. It is concluded that the controlling chemical actions to dissolve the major components are carbon dioxide weathering for the granitiform soil in the alluvial area, while the cation exchange reactions by the clay minerals are dominant in the Neogene area. (Baker-FRC)
W82-04177

2L. Estuaries

THE DISTRIBUTION OF MERCURY, CADMIUM AND LEAD BETWEEN WATER AND SUSPENDED MATTER IN THE LOIRE ESTUARY AS A FUNCTION OF THE HYDROLOGICAL REGIME,

UER des Sciences Pharmaceutiques, Nantes (France). Lab. de Toxicologie.
M. Frenet.
Water Research, Vol 15, No 12, p 1343-1350, December, 1981. 5 Fig, 2 Tab, 17 Ref.

Descriptors: *Estuaries, *Heavy metals, Water pollution sources, *Industrial wastes, *Urban drainage, Cadmium, Mercury, Lead, *Loire Estuary, Suspended sediments, Hydrological regime, France, Path of Pollutants.

Filtered water and suspended sediment samples from the Loire Estuary were examined for mercury, lead, and cadmium concentrations. In both types of samples the metal concentrations varied widely and were found to be functions of hydrodynamic and hydraulic parameters. The distribution of the three metals was closely linked to the urban and industrial environment. Two built-up urban and industrial zones are present, one between Nantes and Le Pellerin, and the other between Paimboeuf and St. Nazaire. The metal content in these two zones is significantly higher than the so-called normal or natural metal content. The main source of lead is road traffic, which is particularly heavy around Nantes and St. Nazaire. Mercury has been linked to the industrial activity in the area and has a regular distribution all along the estuary. Cadmium is present in large quantities down river from Cordemais and can be linked to some of the industries of the Paimboeuf-St. Nazaire zone, such as metallurgy and shipbuilding. (Baker-FRC)
W82-03757

AN ANALYSIS OF SELECTED CLASSES OF ORGANIC CONSTITUENTS IN THE THAMES RIVER ESTUARY,

Connecticut Univ., Storrs.
G. A. Flanigan.
PhD Thesis, 1980. 149 p, 12 Fig, 12 Tab, 72 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; No GAX81-03166.

Descriptors: *Estuaries, *Organic matter, Fatty acids, Organic compounds, Sediments, *Thames River estuary(USA), Sterols, Purgeable organic compounds, Mar Menor(Spain).

Purgeable organic compounds, sterols and fatty acids were studied in the Thames River estuary (U.S.A). Low concentrations of purgeable compounds were found in water samples throughout the estuary; analytical limitations prevented the identification of these compounds. A factorial experiment determined the relative influence of the gas sparging variables (glas flow, salinity, temperature) for the removal of benzene from solution. Sediment samples from the Thames river estuary and Mar Menor (Spain) were analyzed for sterols and fatty acids. These compounds were identified by GC/MS. The relative proportions of the C-27 versus C-29 sterols were correlated with the relative influence of marine versus terrestrial sources of organic matter. Fatty acids were determined for the esterified and free acids forms that were present. The relative proportions and concentrations of the two forms in the Mar Menor samples demonstrated a hydrolysis equilibrium in the sediments. The Thames River data suggested a similar process. A rapid or prior removal of terrestrially derived fatty acids were observed at the fresh/saline boundary of the Thames River estuary. The hydrolysis processes and distribution of sterols, discussed in this study, are applicable to other nearshore environments. (Sinha-OEIS)
W82-03819

THE BACKGROUND TO THE FLOOD DEFENCES OF LONDON AND THE THAMES ESTUARY,
Ministry of Agriculture, Fisheries and Food, London (England).
For primary bibliographic entry see Field 4A.
W82-03895

WATER QUALITY OF THE TIDAL POTOMAC RIVER AND ESTUARY HYDROLOGIC DATA REPORT 1979 WATER YEAR,
Geological Survey, Reston, VA. Water Resources Div.
S. F. Blanchard, and D. C. Hahl.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $19.75, Microfiche $3.50. Geological Survey Open-File Report 81-1074, 1981. 149 p, 6 Fig, 2 Tab, 19 Ref, 3 Append.

Descriptors: *Water quality, *Tidal rivers, *Estuaries, Data collections, Physical properties, Chemical properties, Sampling, Sites, Cross section, Water analysis, *Dissolved solids, Sediments, Dissolved oxygen, Saline water, *Potomac River, Saline water intrusion.

This report contains data on the physical and chemical properties measured during the 1979 water year for the tidal Potomac River and estuary. Data were collected routinely at five major stations and periodically at 14 intervening stations. Each major station represents a cross section through which the transport of selected dissolved and suspended materials will be computed. The intervening stations represent locations at which data were collected for special studies such as: salt water migration, dissolved oxygen dynamics, and other synoptic studies. About 960 samples were analyzed for silicate, Kjeldhal nitrogen, nitrite, phosphorus, chlorophyll and suspended sediment, with additional samples analyzed for organic carbon, calcium, magnesium, sodium, bicarbonate, sulfate, potassium, chloride, fluoride, seston and dissolved solids residue. In addition, about 1400 in-situ measurements of dissolved oxygen, specific conductance, temperature, and Secchi disk transparency are reported. (USGS)
W82-03998

BIOLOGY OF BRACKISH WATER, (IN JAPANESE),
Izumino-machi, Kanazawa (Japan).
K. Mashiko.
Japanese Journal of Limnology, Vol 42, No 2, p 108-116, 1981. 2 Fig, 4 Tab, 54 Ref. (English Summary).

Descriptors: *Brackish water, *Ecosystems, Seawater, Estuarine environment, Evolution, Salinity, Aquatic organisms.

This review discusses the biological significance of brackish waters. Brackish water is taken to mean a mixture of sea water and fresh water. Some researchers consider estuaries separate from brackish water. However, all waters of moderate salinity can be regarded as brackish from the biological point of view. Brackish waters can be divided into two major types, poikilohaline and homoiohaline. Poikilohaline waters are those brackish waters of unstable and variable salinity, temporally but not spatially. Brackish waters of temporally stable salinity are termed homoiohaline. The productivity does not always appear to coincide with increases in nutrient concentrations in poikilohaline brackish waters, because the instability of salinity may result in limiting the immigration of both the marine and the freshwater euryhaline forms. As it is generally felt that life began in the sea and migrated landwards, most of the migration may have begun from entering brackish waters. Homoiosmosity may first have been required by immigrating organisms. (Author's abstract)
W82-04179

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

EVALUATION OF THERMODYNAMICAL EFFICIENCY OF REVERSE OSMOSIS PROCESS USING ENTROPY,
National Inst. for Environmental Studies, Yatabe-Machi, Ibaraki (Japan).
For primary bibliographic entry see Field 5D.
W82-03760

MUNICIPAL ION EXCHANGE: WAITING TO TAKE OFF,
Water Purification Associates, Cambridge, MA.
For primary bibliographic entry see Field 5F.
W82-03837

IMPROVED POROUS SUPPORTS FOR THIN-FILM COMPOSITE REVERSE OSMOSIS MEMBRANES,
FilmTec Corp., Minneapolis, MN.
J. E. Cadotte, R. S. King, J. E. Sand, and R. J. Petersen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-197997, Price codes: A04 in paper copy, A01 in microfiche. Report for Office of Water Research and Technology, November, 1981. 51 p, 2 Fig, 12 Tab, 9 Ref. OWRT-C-00035-S(0443)(1), 14-34-0001-0443.

Descriptors: *Membrane processes, *Membranes, *Reverse osmosis, *Desalination apparatus.

The introduction of the polysulfone support film was a key to the later successful development of thin-film composite reverse osmosis membranes. This support film has changed little since its introduction in 1967. The yield of 'seawater grade' composite membrane is strongly dependent upon the quality of the support film. Therefore, a study was made on casting of polysulfone support films to eliminate such defects as pinholes and macrovoid or microbead formation. Increasing the density of the support film was the only means found to eliminate these defects. The flux inhibiting effect of increased support density was overcome by the use of additives in the casting solution. The additives included certain hydrophilic polymers, polar aromatic materials and surfactants. Also, a new type of support film was developed from polyacrylonitrile for composite membranes. The polyacrylonitrile support film had advantages over polysulfone in its high degree of solvent resistance. Support films fromed from polyacrylonitrile normally shrink and become brittle upon drying. A dry annealing procedure was found that produced a wet-dry stable PAN support film.
W82-03943

DEVELOPMENT OF AN ULTRA-THIN-SKINNED REVERSE OSMOSIS MEMBRANE USING HOMOGENEOUS POROPLASTIC FILM AS THE ULTRAMICROPOROUS SUBSTRATE,
Moleculon Research Corp., Cambridge, MA.
L. D. Nichols, A. S. Obermayer, M. B. Allen, and R. P. Caron.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-197906, Price codes: A03 in paper copy, A01 in microfiche. Report submitted to Office of Water Research and Technology, 33 p, 5 fig, 8 Tab, 13 Ref. OWRT-C-00059-S(0437)(1), 14-34-0001-0437.

Descriptors: *Reverse osmosis, Poroplastic, *Membrane processes, Thin films, Cellulose acetate membranes, Asymmetric membrane, Substrates, *Desalination, *Water treatment.

Moleculon Research Corporation has used Propoplastic cellulose triacetate materials for development of reverse osmosis membranes with improved flux at lower pressures. The limiting factor on membranes relying on a thin, osmotically active skin has been the inability of large substrate pores to support ultra-thin skins. The 15 to 100 Angstroms pore size of Poroplastic substrates offers potential for thinner skins without loss of mechanical integrity. This report describes membrane preparation and testing, and presents performance data together with recommendations for further improvements. The best membranes, obtained by development of thin cellulose triacetate skins directly on Poroplastic substrates through variations in production procedures, provided salt rejection of 97.6% at a flux of 13.2 GFD and a pressure of 800 PSI, comparable with present cellulose diacetate membranes. The higher compaction strength and good chlorine resistance of cellulose triacetate should impart longer lifetime to these new membranes, and further improvements in flux and pressure appear feasible.
W82-03947

ASSESSMENT OF HIGH HEAT-TRANSFER EVAPORATORS AS POWER PLANT CONDENSERS TO PRODUCE ABUNDANT FRESHWATER,
California Univ., Berkeley.
A. D. K. Laird, J. Frisch, and E. F. Ensler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-198045, Price codes: A09 in paper copy, A01 in microfiche. Report (1982). 174 p, 8 Fig, 5 Tab, 8 Ref, 7 Append. OWRT-C-00070-S-(0444)(1), 14-34-0001-0444.

Descriptors: *Water resources development, *Multieffect distillation, *Desalination plants, *Fortran computer programs, *Optimization system analysis, Engineering, Economics.

Energy requirements to produce abundant freshwater from saline water sources suggests the use of high heat-transfer evaporative condensers in power plants where sufficient waste heat is available for distillation. Review of current existence of such dual-purpose plants as well as a discussion of planning for future designs is presented. Computer programs utilizing available engineering equations and cost analysis for multieffect distillation plants have been developed and are presented with example problems. They are particularly useful for analysis of existing designs, and an additional computer code for optimization of new designs has been developed. The examples show appreciable improvement in lowering unit water cost of the product, as well as adjusting such variables as temperature, mass flow rates and evaporator areas. Preliminary computerized calculations show that a two-effect evaporator unit condensing 7 million pounds per hour from a 1,000 MW power plant would produce 23 million gallons per day of freshwater at a cost of less than $1 per thousand gallons.
W82-03949

Group 3A—Saline Water Conversion

A STUDY OF THE MSF DESALINATION PROCESS UTILIZING THE CONTROLLED TWO-PHASE FLOW CONCEPT--PHASE II,
Coury and Associates, Inc., Lakewood, CO.
M. C. Mickley, E. A. Fritzler, and G. E. Coury.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-198086, Price codes: A04 in paper copy, A01 in microfiche. November 1981. 41 p, 16 Fig, 7 Tab, 3 Refs. OWRT-C-90159-D(No 9525)(1), 14-34-0001-9525.

Descriptors: *Multistage flash distillation, *Multiphase flow, *Heat transfer, *Desalination plants, Heat exchangers, *Cost-benefit analysis, Controlled two-phase flow, Multistage flash desalination, Scale control, Distillation.

This study presents a design and cost estimate for a pilot plant using the controlled two-phase flow (CTPF) heat transfer concept. Process conceptual design applications and cost estimates are also discussed. The CTPF concept is achieved by introducing a gas into the tubeside of a large condenser bundle, thus introducing a two-phase mixture within the condenser tubes. This concept has been applied specifically to the multistage flash (MSF) distillation process. The objective of the pilot plant is to enable an extensive analysis and performance evaluation of the two-phase flow system under conditions as may be experienced in a CTPF hybrid plant. The pilot plant is expected to cost $160,000 for capital equipment. The conceputal application studies have indicated that a 14% savings in annual amortized capital and electrical energy cost can be achieved using the CTPF concept in an acid-treated MSF plant corresponding to Universal Design Case No. 6; a 28% savings can be realized using enhanced heat transfer tubes in an acid-treated MSF plant; and a 29% savings can be achieved using the CTPF concept and enhanced heat transfer tubes based on Universal Design Case No. 6.
W82-04084

A STUDY OF THE VACUUM-FREEZING HIGH PRESSURE ICE-MELTING PROCESS,
New Mexico Univ., Albuquerque. Dept. of Chemical and Nuclear Engineering.
C. Y. Cheng.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-200734, Price codes: A05 in paper copy, A01 in microfiche. Report (V 1) No NE-87(81)OWRT-476-2, January, 1981. 72 p, 49 Fig, 5 Tab, 24 Ref. C-80282-S(1)(8528)(1), 14-34-0001-8528.

Descriptors: *Desalination processes, *Separation techniques, Water desalting, Water treatment, Ice, Water purification, Desalting appartus, *Freezing, Flask distillation, Condensation, Evaporation, Sea water, Brackish water, Wastewater treatment, Vapor pressure, High pressure, Phase diagram, Heat transfer, Ice-brine systems, Salinity, Latent heat, Energy, Economics, Feasibility, Thermodynamics, Kinetics, Ice-melting, Ice-vapor interface.

In the study, an aqueous solution was flash vaporized under a reduced pressure to simultaneously form a low pressure water vapor and ice crystals. The ice formed was first purified in a counter-washer and then melted inside of heat conductive conduits under a high pressure (e.g. 500 atm.) and the low pressure water vapor was desublimed to form desublimate (ice) on the outside of the conduits. The latent heat of desublimation released was utilized in supplying the heat needed in the ice-melting operation. The desublimate was removed intermittently by an in-situ dissolution operation utilizing the feed solution and an equivalent amount of ice was formed inside of the conduits. The process uses components that are available commercially and can be reliably operated. The process is highly energy efficient and cost competitive with other desalination processes and conventional evaporation processes. The process is useful in desalination of brackish water and sea water and in concentrating industrial aqueous solutions.
W82-04166

A STUDY OF THE IN-SITU INDIRECT FREEZING PROCESS,
New Mexico Univ., Albuquerque. Dept. of Chemical and Nuclear Engineering.
C. Y. Cheng.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-200742, Price codes: A05 in paper copy, A01 in microfiche. Report (V 2) No. NE-87(81) OWRT-476-2, January, 1981. 140 p, 27 Fig, 2 Tab, 27 Ref. C-80282-S(2), 14-34-0001-8528.

Descriptors: *Separation techniques, *Desalination processes, *Crystallization, Water desalting, Water purification, Desalting apparatus, *Freezing, *Wastewater treatment, Crystal growth, Nucleation, High pressure, Ultrasonics, Phase Diagram, Thermodynamics, Supercooling, Heat transfer, Energy, Melting, Sodium chloride permeability, Ice, Sea water, Brackish water, Brines, In-situ indirect freezing, Smooth deposit, Dendritic deposit, In-situ washing, In-situ melting, Pressure-programmed supersaturation, *Heat reuse, Two-pressure zone simultanous freeze-melt operations, In-situ nucleation, *Purification, Para-xylene, Styrene, Monomers.

It has been demonstrated that high degree separations of aqueous and organic mixtures can be accomplished and an energy saving can be realized by the In Situ indirect freezing process conducted in a small conduit freezer-melter. The process has two versions: the first version, denoted as the dendritic deposit approach, is useful in accomplishing a high degree separation of a concentrated solution and the second version, denoted as the smooth deposit approach, is useful in a high degree purification of a dilute solution. A pressure-induced nucleation approach and a seeded feed approach with ultrasonic nucleation have been introduced to initiate a freezing step uniformly; a pressure-programmed supersaturation approach has been introduced to obtain a close control for heat transfer and a close control of the morphology of the deposited solid phase. Products containing less than 350 ppm Nacl were obtained from feeds containing 40,000 ppm and 5000 ppm respectively by the two approaches.
W82-04168

WATER CONSERVATION UNDER CONDITIONS OF EXTREME SCARCITY: THE U.S. VIRGIN ISLANDS.
Coffin & Richardson, Inc., Boston, MA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-204843, Price codes: A10 in paper copy, A01 in microfiche. Technical Completion Report, December, 1981. 211 p, 5 Fig, 11 Tab, 3 Append. 14-34-0001-9431.

Descriptors: *Water scarcity, *Water conservation, *Water management, *St. Thomas, *Desalination, Aquifers, Brackish water, Collecting areas, Cisterns, Water reuse, Desalination plants, Artificial recharge, Groundwater management, Wastewater irrigation, Water costs, Water demand, Water distribution, Water use, Institutional constraints, Social aspects.

A plan for the optimal development of the limited water resources of St. Thomas, United States Virgin Islands was developed utilizing information from three sources. The three sources consisted of an analysis of the existing political and socioeconomic system, a complete review of literature relating to the resources, culture and history of St. Thomas and other similar communities, and an attitude survey. The analysis of the political socioeconomic system and the literature survey indicated that the existing water management structure is highly fragmented and ineffective and has been the primary cause of the failure of desalination facilities to meet the needs of the community in the past. The attitude survey indicated that the residents of St. Thomas want to see the chronic water problem solved and feel that the government has the responsibility to solve it. The residents feel much of the problem is due to governmental mismanagement, and they think the government could be doing more to rectify the situation. Based on these findings, it was recommended that the existing fragmented management structure be restructured into a single agency and that this agency pursue a course of increased use of desalination to meet the water needs of St. Thomas.
W82-04170

3B. Water Yield Improvement

RESERVOIR OPERATION FOR WATER CONSERVATION,
Texas Univ. at Austin. Center for Research in Water Resources.
L. R. Beard, J. P. Hendrix, and S. Chang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-202110, Price codes: A11 in paper copy, A01 in microfiche. September, 1981. 208 p, 14 Fig, 53 Tab, 47 Ref, 10 Append. OWRT-C-90079-C(9451)(1), 14-34-0001-9451.

Descriptors: *Reservoir operation, *Water conservation, *Reservoir evaporation, Reservoir releases, *Low control, Texas, Computer programs, Evaporation, Reservoirs, Arid lands, Semiaird lands, Humid areas, Two-reservoir systems, Regional analysis, Spillways, Dynamic programming, Optimization, HEC programs, Algorithms, *Model studies, *Simulation analysis, Water demand, California, *Comparison studies.

This research project is an effort to determine the importance and magnitude of evaporation losses in multi-reservoir systems. Computer programs HEC-3 and RESEVAP were used. RESEVAP incorporated a dynamic programming algorithm to determine operating policies for a two-reservoir system. For a given deterministic sequence of hydrology, the program can determine operating policies which satisfy one of three possible objectives: (1) Minimize cumulative evaporation; (2) Minimize cumulative spill; and (3) Minimize cumulative evaporation plus spill. The physical and hydrologic reservoir system characteristics which influence evaporation vary greatly nationwide. The basis of this research project was to simulate the operation of the two-reservoir system as modeled by RESEVAP and actual reservoir systems as modeled by HEC-3 in each of three distinct geographic regions representing arid, semi-arid, and humid locations. For each of the 3 geographic locations, the results of operating policies based on each of the 3 objectives were compared. The concluding studies of this research project examine the impact on evaporation losses of changing selected physical and hydrologic reservoir system characteristics. These characteristics include reservoir inflows, storage-area relationships, evaporation rates and yield quantities.
W82-04165

3C. Use Of Water Of Impaired Quality

MIXED BED TECHNOLOGY FOR POLISHING MAKE-UP WATER AND CONDENSATE RETURN: CONCLUSION,
Rohm and Haas Ltd., Croydon (England).
For primary bibliographic entry see Field 5D.
W82-03774

MASS PRODUCTION OF FRESHWATER ROTIFIERS ON LIQUID WASTES II. MASS PRODUCTION OF BRACHIONUS RUBENS EHRENBERG 1838 IN THE EFFLUENT OF HIGH-RATE ALGAL PONDS USED FOR THE TREATMENT OF PIGGERY WASTE,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Biotechnologie III.
J. Groeneweg, and M. Schluter.
Aquaculture, Vol 15, No 1, p 25-33, July, 1981. 7 Fig, 1 Tab, 19 Ref.

Descriptors: *Aquaculture, *Animal wastes, *Rotifers, Algae, Wastewater treatment, Ponds, Manure, Farm wastes, Growth rates, Nitrates, Effluents.

Effluent from an algal pond used to treat diluted pig manure was fed daily to an indoor culture of rotifers. Up to 580 rotifers per ml were obtained

with food concentrations (mainly Scenedesmus falcatus Chod.) of 580 mg per liter total suspended solids. During the experiment nitrites reached a high of 20 mg per liter without harming rotifer growth. (Cassar-FRC)
W82-03884

POLYCULTURE OF THE FRESHWATER PRAWN, MACROBRACHIUM ROSENBERGII, CHINESE AND COMMON CARPS IN PONDS ENRICHED WITH SWINE MANURE I. INITIAL TRIALS,
Hawaii Univ., Honolulu. Dept. of Animal Sciences.
S. R. Malecha, D. H. Buck, R. J. Baur, and D. R. Onizuka.
Aquaculture, Vol 25, No 2/3, p 101-116, August, 1981. 3 Fig, 3 Tab, 32 Ref.

Descriptors: *Aquaculture, *Shellfish, *Animal wastes, Fish, Carp, Prawns, Swine manure, Manure, Effluents, Ponds, Water quality, Farm wastes, Wastewater treatment.

Freshwater prawns, Macrobrachium rosenbergii, were raised without supplemental feeding in a polyculture system (fish, prawns, and pigs). The experimental ponds were in a series of two, with swine housed on the banks of the first pond, which was stocked with silver, bighead, grass, and common carp at 5500 per ha. The second pond received effluent from the first pond and was stocked with macrophytes and about 750 assorted carp (no common carp). After the fish were established for about 6 weeks, prawns were stocked on June 1, 1978, at 7.9 per sq m in the manure ponds and 4.6 per sq m in the effluent ponds. Biomass gains as of October 12, 1978, were: fish, 2516 kg per ha in the manure pond and 613 kg per ha in the effluent pond; prawns, 323.3 kg per ha at average weights of 12.7 g. The effluent ponds had better water quality than the manure ponds with respect to dissolved oxygen, turbidity, suspended solids, and BOD. (Cassar-FRC)
W82-03900

IRRIGATING WITH MUNICIPAL EFFLUENT: A SOCIOECONOMIC STUDY OF COMMUNITY EXPERIENCES,
Economic Research Service, Washington, DC.
L. A. Christensen.
ERS-672, January, 1982. 53 p, 5 Tab, 61 Ref.

Descriptors: *Wastewater irrigation, *Land disposal, *Economic aspects, *Wastewater treatment, Wastewater farming, Wastewater disposal, Rapid infiltration, Irrigation water, Nutrients, Wastewater renovation, Municipal wastewater.

The long-term experiences of eight communities using land treatment of municipal effluent were examined, to provide information on socioeconomic issues to other communities considering the adoption of land treatment systems. No distinct ownership and management patterns emerged among the communities studied. Community size had little influence on the choice. Factors which seemed to influence the methods selected included site specific technical factors; the political, social, and regulatory environment; and local custom and entrepreneurship. All rapid infiltration systems were owned and managed by the community they served. Greater variety existed among communities irrigating crops with effluent. Both community officials and farmers were aware of the economic value of effluent, both as a source of irrigation water and a source of nutrients, but the resources were not being used economically. Farmers generally paid the communities for the use of effluent, but they had not reduced commercial fertilizer application rates. City officials recognized the value of effluent, but did not charge for its full value. Community needs for wastewater treatment, together with farmers who perceived an opportunity for improving their supply of water and nutrients at a low cost, led to the initial development of several of the systems. Factors identified as important for successful systems operation included a long planning horizon and good working relationships between community officials and landowners. (Moore-SRC)
W82-03967

SEWAGE IRRIGATION AND RECHARGE CONSEQUENCES, OAHU,
Hawaii Univ. at Manoa, Honolulu. Dept. of Civil Engineering.
G. L. Dugan, and L. S. Lau.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 669-711, August, 1981. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Wastewater irrigation, *Groundwater recharge, Wastewater disposal, Impaired water use, Land disposal, Irrigation, Potential water supply, *Hawaii, *Oahu.

The island of Oahu, Hawaii has an immediate need to examine methods, including sewage irrigation, which could be used to enhance the island's freshwater sources over the next 20 years. The year 2000 is projected as the time when Oahu's water demand will approach its fully-developed freshwater supply. If population growth is to continue, water reclamation and reuse and significant water conservation measures must receive high priority. Several research projects involving the application of secondary sewage effluent to grassland and sugarcane have recently been completed on Oahu. These projects have demonstrated that secondary sewage effluent does not have a detrimental effect on vegetation or public health and that the quality of leachate below the root zone is similar to conventional agricultural practices. The effluent, which serves as a fertilizer, can be continuously applied as 25 percent of the total irrigation water or can be used full strength during the first year of the 2-year crop cycle with ditch water used thereafter. It appears that there is an adequate quantity of treated sewage effluent available on Oahu to serve both as a freshwater supplement for irrigation purposes and as an additional water source for groundwater recharge. (Carroll-FRC)
W82-04041

POST-SECONDARY TREATMENT OF EFFLUENT FOR DRIP IRRIGATION: JULY 1977 TO MARCH 1980, PHASE II-B,
Hawaii Univ., Honolulu. Water Resources Research Center.
S. L. Lau, R. H. F. Young, and G. P. Young.
Technical Report No 135, January, 1981. 67 p, 24 Fig, 3 Tab, 45 Ref, 3 Append.

Descriptors: *Effluents, *Irrigation ditches, *Irrigation water, *Wastewater treatment, *Drip irrigation, Filters, Sewer systems, Backwash, Sand filters, Suspended solids, Secondary wastewater treatment, Chlorination, Chemical treatment, Impaired water use, *Oahu, Hawaii.

Domestic secondary effluent can be used as supplemental irrigation water for sugarcane with no detriment to sugar yield; however, plugging of the drip-tube orifices, due to suspended material in the water, causes problems. A pilot-tube program, using four types of effluent processed through postsecondary treatment, was unsuccessful. A later modification consisted of diluting 25% Mililane Sewage Treatment Plant (STP) effluent with 75% Waiahole Ditch water in lieu of the original two sources (100% effluent; 50% effluent/50% ditch water mix); changing the filter from a horizontal to a vertical flow; using chlorination only; and adjusting operations to reduce plugging of filters. Less than 10% plugging of the drip lateral emitters was achieved for the first half of the operating period, but the system overloaded when the Mililane STP effluent deteriorated because of peaks in suspended solids. The single media pressure vertical sand filter reduced the 75% ditch water/25% Mililane effluent to a level about equal to the ditch water after reservoir storage. Backwash water usage was as low as 8%. Subsequent operations corresponding to major changes in Mililane operations yielded abnormal performances, with plugging recorded between 40% to 50% while the STP effluent suspended solids were as high as 141 mg/l. Rejuvenation of the drip tubing was gradually achieved with various remedial measures. The posttreatment operation was terminated after three months because of lack of ditch water. (Atkins-Omniplan)
W82-04082

DUAL DISTRIBUTION SYSTEMS ANALYSIS,
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5F.
W82-04123

DENVER'S POTABLE REUSE PROJECT: PATHWAY TO PUBLIC ACCEPTANCE,
Denver Water Dept., CO
S. W. Work, M. R. Rothberg, and K. J. Miller.
Journal of the American Water Works Association, Vol 72, No 8, p 435-440, 1980. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Water reuse, *Metropolitan water management, Water supply development, *Water treatment, Water management, *Water demand, *Denver, Colorado, Public opinion.

Increasing needs for water in the Denver area have led to serious consideration of water reuse. No program for reuse of water can succeed without the support of the public, including not only the consumers but public health authorities as well. Quality standards for reuse of water are currently lacking, leaving two alternatives for an agency considering potable reuse. One is to conduct in-depth toxicological and epidemiological studies over a period of years to indicate any health problems and to provide background criteria for workable standards. The other is to adequately monitor wastewater quality and remove the amount of pollution added between the water supply and the wastewater treatment facility. In order to be certain that pollutant removals are being accomplished, an extensive battery of toxicological examinations should be performed on the product water. A plant-scale demonstration prior to full scale implementation is recommended. A 3.3-ML/day demonstration plant is suggested as being most desirable in size. (Baker-FRC)
W82-04140

THE EFFECT OF REUSE OF WATER FOR AGRICULTURE ON THE ARAB-ASIAN SOCIETY: A NEW INTERDISCIPLINARY MODEL FOR UNDERSTANDING A DEVELOPMENT PROBLEM,
Oklahoma Univ., Norman.
A. M. Yunis.
PhD Thesis, 1980. 283 p, 13 Fig, 29 Tab, 113 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-16939.

Descriptors: *Water reuse, *Wastewater renovation, *Irrigation, *Arid lands, Agriculture, Social aspects, Social change, Developing countries.

The arid countries of the Arab-Asian region face a serious water shortage problem. This dissertation analyses the problem projecting the likelihood of its solution in view of the current trends as well as the technological measures used in dealing with it. An alternative solution in the technology of wastewater reuse for agriculture is offered. In order to try to insure the effecient transfer of wastewater reuse technology into the society an interdisciplinary model is set up for approaching this development problem. The approach is based on an important new concept of the term development. In this study, the redefined development is seen as an on-going interaction process between water (other resources), society (demographic, socio-economic, and social organization), environment (pollution), and technology. Water adequacy, its technological solution and impact, interdisciplinary problem is built into the on-going system of interaction in the development process. The potential social impact of wastewater reuse technology for irrigation is programmed from the start to overcome societal constraints. Two alternative futures are compared in the development process: (1) The future development process without wastewater reuse as extrapolated from the present on-going interaction process, and (2) an alternative future with wastewater reuse derived from the present on-going interaction process. The study establishes that wastewater reuse technology will have beneficial impacts on social concerns in the region and that successful diffusion of the technology depends on putting high priority on resolving societal constraints at the rural level. (Sinha-OEIS)
W82-04213

3D. Conservation In Domestic and Municipal Use

USE OF A PREDICTIVE MODEL IN EVALUATING WATER CONSUMPTION CONSERVATION,
Iowa State Univ., Ames. Dept. of Sociology and Anthropology.
M. Y. Lee, and R. D. Warren.
Water Resources Bulletin, Vol 17, No 6, p 948-955, December, 1981. 3 Tab, 6 Ref.

Descriptors: *Water consumption, *Water conservation, *Water policy, Water use, *Model studies, Water shortage, Drought, *Iowa, Model studies, Local governments, Predictive model, Planning, Social aspects, Political aspects.

A multiple regression predictive model was used to evaluate the effectiveness of water conservation policies on reduction of water consumption. Data from 8 Iowa communities varying in size, degree of urbanization, and degree of industrialization were collected from the summers of 1976, 1977 (a severe drought year), and 1978. The model considers precipitation, temperature, month effects, and the nature of the community. It produces a conservation score which is more accurate than a percentage change in use as compared with a previous year. The most effective water conservation policy was mandatory water restrictions with specified per capita limits. Voluntary conservation also significantly reduced consumption in some nearby communities experiencing less severe shortages. The most important factor in successful conservation was the credibility of the local governments and cooperation of the communications media with respect to water shortage information. The model can be used to predict water consumption for either a summer month or year-round by choosing one of the sample communities nearest to the desired population and characteristics, then inserting appropriate data into an equation. (Cassar-FRC)
W82-03754

HOUSEHOLD WATER USE: TECHNOLOGICAL SHIFTS AND CONSERVATION IMPLICATIONS,
Indiana State Budget Agency. Indianapolis.
R. L. Clouser, and W. L. Miller.
Water Resources Bulletin, Vol 16, No 3, p 453-458, June, 1980. 4 Tab, 9 Ref.

Descriptors: *Water consumption, *Water conservation, *Domestic water, *Water use, Surveys, Water policy, Subsidies, *Cost-benefit analysis, Benefits.

The effect of water intensive appliances and activities (washing machine, dishwasher, swimming pool, and lawn watering) on household water consumption was determined from questionnaires mailed to households in two communities. All of the activities investigated increased household water use during at least some of the time periods (December-March, April-July, and August-November). Contrary to published reports, use of a dishwasher increased household water consumption. Persons answering the questionnaires were not generally familiar with household water saving devices. Installation of such water conservation measures would produce small benefits to an individual household (about $42 a year) at the prevalent low water prices, $1-$3 per 1000 gal. However, aggregate community benefits would be significant if costs in additional water facilities would be avoided. Subsidy of water saving devices, which can reduce total community consumption by 20%, may be an alternative water management policy for some communities. (Cassar-FRC)
W82-03910

WATER REQUIREMENTS OF URBAN PLANTS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
J. B. Desai.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-197880, Price codes: A06 in paper copy, A01 in microfiche. MS Thesis, 1981. OWRT A-084-ARIZ(2), 14-34-0001-9003.

Descriptors: Water use, *Plant growth, Surface irrigation, *Water requirements, *Irrigation efficiency, Comparison studies, Trees, Shrubs, Grasses, Water conservation, *Urban plants, Plant appearance, Trickle irrigation, Spray irrigation, *Arizona.

Sixteen species of trees, shrubs and ground covers, commonly used in landscape designs in southern Arizona, were given high, medium, and low water treatments under trickle and spray irrigation systems. Annual water deliveries for these plant species were obtained. Well distributed summer rains substantially reduced the irrigation needs of these plants, and all the plant species were reasonably maintained under trickle irrigation, with less than one-gallon-per-day water deliveries, except Mulberry. Plants were grouped into four categories according to their annual water deliveries, viz., very high, high, medium, and low water users. Trickle-irrigated plants made almost equal growth and maintained similar appearances as spray-irrigated plants, which were given more water. The data on plant growth increments were analyzed for selected ten plant species to determine the effects of reduced water treatments. None of the plant species showed significant linear or quadratic relationships with water levels except Privet, which showed significant linear relationship with high, medium, and low water treatments for plant height and plant spread.
W82-03972

THE EFFECTS OF WATER CONSERVATION KITS ON WATER USE,
California Univ., Santa Barbara.
W. D. Morgan, and P. Pelosi.
Journal of the American Water Works Association, Vol 72, No 3, p 131-133, March, 1980. 1 Fig, 7 Tab.

Descriptors: *Water conservation, *Water consumption, *Economic aspects, Water use, Social aspects, *Oxnard, *California, Domestic water.

The City of Oxnard, California, distributed 3200 free water conservation kits consisting of a water guard to reduce quantity of water flushed in the toilet, a shower head flow restrictor, and dye tablets to detect leaks in toilet storage tanks. A survey of 616 of these households one month after distribution showed that 63% installed the kits and 37% did not. Households which installed the conservation kits had more bathrooms, higher assessed values of the homes, more water using appliances, and a higher percentage of professional and management heads of households. Households with heads between ages of 35-44 and over 65 had the lowest installation rates. There was very little difference in installation rates in houses of different ages. About 88% of the persons who installed devices were satisfied with their operation. Water savings for installers were 3%, or about 18 cu meters per year each. At a water rate of 9 cents per cu m, a $1.50 kit would pay for itself in 1 year. (Cassar-FRC)
W82-04121

WATER CONSERVATION UNDER CONDITIONS OF EXTREME SCARCITY: THE U.S. VIRGIN ISLANDS,
Coffin & Richardson, Inc., Boston, MA.
For primary bibliographic entry see Field 3A.
W82-04170

ACHIEVING URBAN WATER CONSERVATION,
Colorado Univ., Boulder. Dept. of Civil, Environmental and Architectural Engineering.
J. E. Flack.
Water Resources Bulletin, Vol 16, No 1, p 139-141, February, 1980. 6 Ref.

Descriptors: *Water conservation, *Water demand, *Municipal water, Urban areas, Metering, Water use, Conservation, Domestic water, *Pricing, Economic aspects, Water pressure, Water loss.

Urban water conservation as an alternative to additional raw water supply is discussed as an increasingly valid course of action. Some of the conservation possibilities for urban water demand are discussed in this article. Metering of formerly flat-rate charged residential water users can reduce water consumption substantially. Water saving plumbing devices have been advocated as low in cost, easy to install, and effective in reducing domestic water use. The use of price policies to conserve water has been demonstrated effective if the price changes are significant and well publicized. Restricting water usage, typically outdoor watering, to specified days and/or hours reduces the peak demands on the water distribution system. Some utilities with high pressures and/or large leakage losses have found that concerted efforts to reduce system pressures to about 40-60 psi and control main losses to about 10-15 percent of system delivery are both cost effective and conserving of water supply. Alteration of landscaping may become a major conservation practice of the future. Reduction in lawn sizes, increases in impervious area and planting of low water using plants and trees can be combined with landscape architecture to produce urban communities that are more closely adapted with the local climate and thus less costly to maintain. (Baker-FRC)
W82-04227

WATER SAVINGS FROM LAWN WATERING RESTRICTIONS DURING A DROUGHT YEAR, FORT COLLINS, COLORADO,
Science and Education Administration, Fort Collins, CO; and Economics, Statistics, and Cooperatives Service, Washington, DC.
R. L. Anderson, T. A. Miller, and M. C. Washburn.
Water Resources Bulletin, Vol 16, No 4, p 642-645, August, 1980. 1 Fig, 2 Tab, 2 Ref.

Descriptors: *Water use, *Lawns, *Irrigation, *Fort Collins, Colorado, Semiarid climates, Water consumption, *Water conservation, Evapotranspiration, Landscaping, Drought, Municipal water, Regulations, *Lawn watering restrictions.

Water use in Fort Collins, Colorado, during a 6-week period of lawn watering restrictions in the summer of 1977 decreased by 41% compared with the previous year. The schedule allowed twice a week watering according to house address number. However, abnormally wet weather lowered evapotranspiration considerably during this period. It was calculated that the lawn watering restrictions saved 603 acre-feet of water and that the wet weather saved 659 acre feet. In a normal year the restrictions would be expected to save only 19.7%. Those persons who irrigate lawns efficiently did not reduce water consumption; they only changed the time of application. Most property owners are willing to pay for water to maintain attractive landscaping, which adds 10-15% to the value of a home in this semiarid region. (Cassar-FRC)
W82-04232

3F. Conservation In Agriculture

EFFECT OF FIELD LEVELLING QUALITY ON IRRIGATION EFFICIENCY AND CROP YIELD,
Haryana Agricultural Univ., Hissar (India). Dept. of Soils.
M. C. Agarwal, and A. C. Goel.
Agricultural Water Management, Vol 4, No 4, p 457-464, December, 1981. 4 Tab, 16 Ref.

Descriptors: *Irrigation efficiency, *Soil engineering, *Crop yield, Irrigation, Water demand, Water use efficiency, Water use, *India.

An assessment was made of land leveling work being done in newly canal commanded areas. To perform this assessment, use was made of the land leveling index, which differs from the land uniformity coefficient used prior to this study. It may be defined as the average numerical variation (cm) between the proposed or design level, and the existing average field level, either before or after the completion of leveling work. The prevalent

deficiency in leveling quality was found to range from 21.4% to 42.2%. Field studies have assessed quantitatively the effect of land leveling quality on irrigation and water use efficiencies and crop yield. The study comprised five leveling indices, 1.2, 2.0, 2.5, 3.0, and 3.7 cm, and two irrigation treatments, fixed depth and complete irrigation. The irrigation application, distribution, and water use efficiency were appreciably reduced with increases in leveling index or deterioration in leveling quality. The wheat grain yield was significantly reduced for leveling index values higher than 2.5 cm. The fixed irrigation depth treatment gave better results from the viewpoint of water economy than did the complete irrigation treatment. From this study it was inferred that in order to obtain reasonably high yield and judicious use of water at a reasonable cost, the field lveling index should not have a value greater than 3.0 cm. Adoption of this criterion will greatly help to minimize the large gap existing between the irrigation potential created and that acutally used beneficially. (Baker-FRC)
W82-03789

LEACHING REQUIREMENTS FOR SALINITY CONTROL. II. OAT, TOMATO, AND CAULIFLOWER,
Science and Education Administration, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 2I.
W82-03790

OPTIMAL RESERVOIR MANAGEMENT AND CROP PLANNING UNDER DETERMINISTIC AND STOCHASTIC INFLOWS,
Indian Agricultural Research Inst., New Delhi. Div. of Agricultural Economics.
C. C. Maji, and E. O. Heady.
Water Resources Bulletin, Vol 16, No 3, p 438-443, June, 1980. 4 Tab, 13 Ref.

Descriptors: *Reservoir operation, *Irrigation practices, *Crop production, Model studies, Water allocation, Stochastic hydrology, Agriculture, Economic aspects, Employment, *Mayurakshi irrigation project, *India.

The 530,530 acre Mayurakshi irrigation project in eastern India was analyzed by two models, deterministic and chance constrained. These models indicated the optimal storage of reservoir water, the transfer of water to the producing regions, and the spillage of water from the reservoir. Both models suggest changes in the traditional cropping program--less emphasis on kharif (June-December) irrigation and more on rabi (October-April) irrigation and increases in cropping intensity from 103% to 129%. In the deterministic model best results are obtained with 110,370 acres of wheat and high-yield rice and 1,700 acres of sugarcane under rabi irrigation. Most of the kharif rice remains unirrigated. In the change constrained model the wheat and rice irrigation patterns are similar, and potato replaces sugarcane. The deterministic model suggests that the reservoir be empty in the beginning of the kharif season, but the chance constrained model allows for storage of 53,760 acre ft of water, a decision which allows for delay in the onset of the monsoon. The optimal cropping pattern would increase farm employment from the present 38% to 46% and 42% in the deterministic and change constrained models, respectively, and net farm income by 33% and 15%, respectively. (Cassar-FRC)
W82-03914

WATER CONSERVATION IN COTTON BY DROUGHT INDUCED LEAF SURFACE WAX SYNTHESIS,
Auburn Univ., AL. Dept. of Botany, Plant Pathology and Microbiology.
J. D. Weete, and C. M. Peterson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-197963, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, December 1, 1981. 9 p. OWRT A-071-ALA(1), 14-34-0001-1001.

Descriptors: *Cotton, *Leaf surface wax, Synthesis, Transpiration, Water conservation, Plant water potential, Leaves.

Experiments were conducted to determine the water potential at which surface wax synthesis and deposition in cotton leaves could be stimulated, and estimate the contribution of the increased wax to water conservation in the leaf. Cuticular transpiration to wax content was determined by measuring water loss gravimetrically from leaf discs with stomates closed and different amounts of wax. Also, water-stress and plant hormone effects on leaf lipid and wax metabolism was determined using radiochemical techniques. Leaf water potentials of -24 to -32 bars for 6 days are sufficient to predispose cotton plants to increased wax production after rehydration for 24 hours. Wax removal may result in at least a 577% increase in water loss through the cuticle. Wax synthesis stimulation appears to result from a buildup of lipid during the stress period due to a stimulation of fatty acid synthesis. Fatty acids are substrates for wax synthesis. Stimulation of falactolipase and -galactosidase occurs in water-stressed leaves and is probably responsible for chloroplast degradation observed previously. Stimulation of the enzyme activity is not via effects on hormones, since IAA, Kinetin, GA, CAMP, and ABA could not reproduce the water-stress response with respect to the galactolipase and -galactosidase activity.
W82-03946

SUGAR BEET PRODUCTION AS INFLUENCED BY WATER STRESS,
Colorado State Univ., Fort Collins.
T. E. Flack.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-197898, Price codes: A05 in paper copy, A01 in microfiche. MS Thesis, Fall 1981. 70 p, 14 Fig, 7 Tab, 37 Ref, 6 Append. OWRT-B-176-COLO(1).

Descriptors: *Sugar beets, Production function, *Water stress, Evapotranspiration, Beets, Stress-yield relations, *Irrigation efficiency, *Crop production.

Irrigation water supplies are becoming expensive and scarce in the western United States. As a water management tool, production functions indicating relationships beween crop yields and evapotranspiration have been utilized. Models have been developed using this information. Transferability of these models is dependent upon understanding the moisture extraction characteristics for a given crop under a given set of climatic and soil conditions. Therefore, a wide range of water stress conditions must be produced. The objective of our research was to generate production function data for sugar beets (Beta vulgaris L.) as influenced by drought stress under irrigation. Sugar beets were sprinkler-irrigated in 1980 using a line source continuous variable experimental design which produced six water application levels (1 through 6 wettest)). Treatment variables included preplant and no preplant irrigation (Si and So) and full-season irrigation (II) versus early season (IO) and late season)OI) irrigation. Yield components included fresh root tonnage, sucrose percent, sucrose yield, top dry matter, and total dry matter production. Effect of delayed harvest on sucrose yield was also examined. Evapotranspiration was measured throughout the growing season using a water balanced method. A neutron probe depth moisture gauge was used to monitor changes in soil water within the root zone.
W82-04086

IMPROVED WATER AND NUTRIENT MANAGEMENT THROUGH HIGH-FREQUENCY IRRIGATION - VOL I: COMPARISON OF METHODS FOR DETERMINING SOIL HYDRAULIC CHARACTERISTICS,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
T. A. Howell, M. J. McFarland, D. L. Reddell, K. W... Brown, and R. J. Newton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-204850, Price codes: A06 in paper copy, A01 in microfiche. Report No 113, V 1, December 1980. 95 p, 33 Fig, 10 Tab, 24 Ref, 1 Append. B-219-TEX(1), 14-34-0001-8121.

Descriptors: *Soil moisture movement, *Irrigation, Drainage, Runoff control, Hydraulic properties, *Hydraulic conductivity, Tensiometers, Neutron probe, Water retention curve, Soil moisture meters, Sampling, Testing procedures, Field tests, Laboratory tests, Water management.

This study determined the principal hydraulic properties of a soil of the Norwood Series utilizing in situ measurement, laboratory measurements, and theoretical models. The laboratory method selected was centrifugation. Soil cores were centrifuged and the redistribution of water was measured as change in weight with time. Hydraulic conductivity was obtained by measurement of hydraulic head and moisture content of the procedure utilized water retentivity curves in conjunction with values of saturated hydraulic conductivity for computing hydraulic conductivity as a function of water content. Saturated hydraulic conductivity was measured in the field using Bouwer's double-tube method. The pressure-water content curves were obtained with disturbed soil samples for 30 to 80 cm depths and with soil cores for 0 to 15 cm. Comparison of calculated values with field data using only the laboratory water retention curves gave good results for the 0 to 10 cm depth and mediocre results for the 30 to 80 cm depth. However, when the field and laboratory data were combined and the resulting water retention curve was used to calculate hydraulic activity, the correlation was greatly improved.
W82-04169

YIELD AND WATER EXPENSE OF COWPEA, CLUSTERBEAN AND SESBANIA AS SUMMER GREEN MANURES IN SEMI-ARID REGIONS OF PUNJAB,
Punjab Agricultural Univ., Ludhiana, (India).
N. T. Singh, R. Singh, and A. C. Vig.
Indian Journal of Agricultural Sciences, Vol 51, No 6, p 417-421, June, 1981. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Semiarid lands, *Manure, *India, *Crop yield, Arid lands, Water use, Costs, Water use efficiency, *Cowpea, *Irrigation, Sesbania, Clusterbean.

Yields and water expenses of cowpea, clusterbean and sesbania grown as summer green manures were compared for use in a maize-wheat or rice-wheat rotation. The experiment was conducted from 1976 to 1978 on a Samona loamy sand low in organic matter and retaining 8.5% water at 0.33 bar suction and 3.5% water at 15 bar suction. Crops were irrigated at ratios of 1.0, 0.7, and 0.5 between the depth of irrigation water applied and evaporation from US Weather Bureau Class A pan. Each irrigation application was 7.0 cm. The rate of production of dry matter throughout the growth period was highest in cowpea, followed by sesbania and slusterbean. Cowpea recorded maximum nitrogen in the tops, followed by sesbania and clusterbean. Sesbania consumed maximum and cowpea minimum water during the growth period. The water expense decreased with an increase in the interval between irrigations. Cowpea gave maximum nitrogen per centimeter water expense. The water-expense efficiency was lowest in sesbania. The nitrogen turnover can be maximized in cowpea if the irrigation interval is reduced, but the same is not true for clusterbean. Cowpea, which showed greater efficiency in water expense at the irrigation levels, seems to be a better green manure than clusterbean and sesbania for total turnover of dry matter and nitrogen per unit of time and per unit of water expense. (Baker-FRC)
W82-04178

PROTEIN AND FREE AMINO ACIDS IN FIELD-GROWN COWPEA SEEDS AS AFFECTED BY WATER STRESS AT VARIOUS GROWTH STAGES,
California Univ., Riverside. Dept. of Botany and Plant Sciences.
C. K. Labanauskas, P. Shouse, L. H. Stolzy, and M. F. Handy.
Plant and Soil, Vol 63, No 3, p 355-360, 1981. 3 Tab, 18 Ref.

Descriptors: *Water stress, *Amino acids, Moisture stress, Stress, Water availability, *Proteins, Cowpea seeds.

This study was undertaken to evaluate water stress effects during various growth stages on the protein and free amino acid content of cowpea seeds. Effects were measured during periods of vegetative, flowering or pod-filling stages. Protein-arginine, -threonine, -serine, -cystine, -valine, -methionine, and -isoleucine were significantly affected by water stress at the three growth stages. There was no consistent pattern in the effect of water stress on the individual amino acids. Irrigation treatments significantly affected practically all of the free amino acid fractions in the cowpea seeds with the exception of glycine, cystine, and tyrosine. Water stress during the flowering and pod-filling stages increased the free amino acid pool, and at the same time inhibited incorporation of the amino acids into the protein chain, thus lowering the protein amino acid fraction simultaneously. The essential amino acids in the seeds were present at concentrations equal to or greater than those recommended by the World Health Organization with the exception of methionine plus cystine. The concentration of lysine in the cowpeas was substantially higher than that found in wheat grain. (Baker-FRC)
W82-04184

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

DISCUSSION: WATER QUALITY TRAP EFFICIENCY OF STORM WATER MANAGEMENT BASINS, BY RICHARD H. MCCUEN,
Duke Univ., Durham, NC. Dept. of Civil Engineering.
M. A. Medina.
Water Resources Bulletin, Vol 17, No 1, p 147-149, February, 1981. 3 Fig, 9 Ref.

Descriptors: *Storm water, *Water management, Storm drainage, Storm runoff, Water quality, Drainage basins, Water management, Storms, *Detention time.

Trap efficiency of storm water detention basins was estimated in a recent article by relating the mass rates of water quality parameters to detention basin inflow rates through statistical regression and definition of a peak reduction factor. Both the trap efficiency and the peak reduction factor were related only to land use and precipitation characteristics. However, the detention basin design characteristics such as storage volume, basin length, and detention time are significant factors as well. Use of the storage/treatment system model incorporating this information indicates a very significant potential for the reduction of urban pollutant mass flow rates with detention devices. (See Abstract No W79-00551 for subject paper) (Baker-FRC)
W82-03784

THE BACKGROUND TO THE FLOOD DEFENCES OF LONDON AND THE THAMES ESTUARY,
Ministry of Agriculture, Fisheries and Food, London (England).
B. D. Trafford.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 5, p 383-397, September, 1981. 6 Fig, 2 Tab, 10 Ref.

Descriptors: *Estuaries, *Flood control, *Thames Estuary, *England, Floods, Barriers, London, *Tidal floods, Storm surges.

The Thames is made vulnerable to flooding by the rise of tidal levels and the effect of storm surges in the North Sea. Increased protection is needed, and funds are now available. The main feature of the protection is the barrier at Woolwich, but works include other barriers as well on tributaries and about 112 km of flood walls or banks. Completion of the plan is scheduled for 1982 and will provide protection against a flood which has a probability of occurring on the average of once in any 1000 years. The warning system which will trigger the closure of the defenses is discussed, along with potential future developments. The present condition in the area indicates that the keystone of the Thames defenses is the barrier at Silvertown. The target date for having the barrier operable is December 1982, and the work is currently proceeding on schedule. Despite well-publicized cost increases on the Silvertown barrier itself, costs of the downstream works have actually fallen in real terms due to savings made at detail design stage. Future improvements in the warning system are likely due to increased refinements in the mathematical model of the waters around the British Isles. It is also hoped to integrate the actual tidal data and the three existing mathematical models so that increasingly detailed predictions can be made starting from the meteorological conditions far out in the Atlantic and progressively zeroing in on the Thames estuary. (Baker-FRC)
W82-03895

AGGREGATION-DISAGGREGATION TECHNIQUES FOR THE OPERATION OF MULTI-RESERVOIR SYSTEMS,
Colorado Water Resources Research Inst., Fort Collins.
For primary bibliographic entry see Field 6A.
W82-03954

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1979 -- NOVEMBER 30, 1980,
Geological Survey, Reston VA. Water Resources Div.; and Geological Survey, Milford, PA. Water Resources Div.
F. T. Schaefer, and R. E. Fish.
Geological Survey Delaware River Master Report, 1981. 101 p, 7 Fig, 2 Plates, 19 Tab, Append.

Descriptors: *Reservoir operation, *Reservoir storage, *Reservoir releases, *Water quality, Hydrologic data, Streamflow, Flow control, Hydrologic budget, Water supply, Water distribution, Diversion, *Water management, Reservoir yield, Estuaries, Water analysis, Saline water intrusion, *Delaware River, New Jersey, New York, Pennsylvania.

A Decree of the U.S. Supreme Court in 1954 established the position of Delaware River Master. The Decree authorizes diversions of water from the Delaware River basin and requires releases from certain reservoirs of the City of New York to be made under the supervision and direction of the River Master. Reports to the Court, not less frequently than annually, were stipulated. Water supply conditions for the year ending November 30, 1980, were in marked contrast to those for the previous 8 years. Discharge of the Delaware River at Montague, New Jersey, was only 68 percent of median as compared to 33 percent in excess of median the previous year. In early October, with reservoir storage declining rapidly, the River Master proposed reductions in both diversions and releases. With consent of all the parties, reductions were effected on October 17 and further reductions were placed in effect in November. At year end, New York City was restricted to 580 million gallons per day, New Jersey to 65 million gallons per day, and the required discharge at Montague was targeted at 1,560 cubic feet per second. Water quality of the Delaware River and Estuary was monitored on a continuous basis at eight sites and on a monthly basis at ten sites to accurately locate the salt front. (USGS)
W82-03989

THE THAMES BARRIER,
R. W. Horner.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 5, p 398-411, September, 1981. 2 Fig, 2 Ref.

Descriptors: *Flood control, *Barriers, *England, *Thames River, Construction, *Flood protection, Model studies, Design criteria, Floodgates, Warning systems.

Due to a high degree of flood risk to a large area of London and the adverse trend of high waters relative to land levels in south east England, a decision was made to construct a flood defense barrier in the western half of Woolwich Reach. The background of the design of the structure and details of the progress of the construction to date are presented in this review. Not only will the barrier offer flood protection, but it will also improve water quality, offer an additional supply of industrial water, improve water transport facilities, and increase amenity and recreation facilities. A comprehensive research program was carried out using physical and mathematical models to provide the information needed for the selection of the site and design of the structure. These included hydraulic and siltation studies, mathematical model studies, studies of the hydraulic characteristics of various gate designs, structural and hydraulic studies, and other detailed investigations. The effectiveness of the Barrier as a method of flood defense depends entirely on closure of the gates before sufficient water has passed the structure under surge tide conditions to cause flooding upstream. Closure of the gates must occur at least one hour before danger level is reached at Woolwich. A surge tide may reach danger level 1.5 to 2.0 hr before predicted high water, or 2.5 to 3.0 hr after predicted low water. The warning system must be able to sense dangerous conditions at least half an hour before the predicted low water preceding and exceptional high water. (Baker-FRC)
W82-04039

PANOCHE CREEK FLOOD PROTECTION WORKS.
Bureau of Reclamation, Sacramento, CA.
Special Report, December, 1981. 66 p, 4 Fig, 5 Tab, 1 Append.

Descriptors: *Flood protection, *Sediment load, *Storm runoff, *Cost-benefit analysis, Environmental effects, Flood control, Sediment erosion, Wetlands, Flooding, Dams, Reservoirs, *Panoche Creek, California, Mendota area.

Highly productive agricultural lands northwest of the city of Mendota, California, and to a lesser extent the city itself, are subject to damaging floods along Panoche Creek. The Panoche Creek flood problem is intensified by sediment deposition. Soils eroded during heavy rains are washed into gullies and stream channels and carried downstream by floodflows, where they are deposited on inundated lands, in flood-relief drains, and on areas where floodwaters pond. Three basic flood protection alternatives were evaluated: two upstream detention dams and reservoirs; a single downstream detention dam and reservoir with provision for a small downstream floodway; and a diversion dam with a large floodway and a sediment retention basin. The alternative providing for two detention dams and reservoirs was not persued after economic analysis showed that its cost would be prohibitive. All the alternatives would provide protection from small, frequent floods, and reduce damage from larger, less frequent floods. However, lands inundated during larger floods could include agricultural areas that are not now subject to flooding. All the alternatives, particularly the diversion dam facilities, would have only limited capacity for the large volumes of sediment generated by storm runoff. Operation and maintenance costs associated with sediment deposition would be high. The principle environmental concerns are associated with endangered species and development within wetland areas. The results of economic analysis show that none of the alternatives evaluated are economically justified. (Moore-SRC)
W82-04068

DRAINAGE OF AGRICULTURAL LANDS.
1978 Census of Agriculture, Vol 5, Special Reports, Part 5, AC78-SR-5, October 1981. 98 p, 3 Fig, 3 Tab, 2 Append.

Descriptors: *Drainage, *Drainage districts, *Agriculture, Surveys, *Cropland, Pastures, Farms, Forests, Land use, United States.

Data from the 1978 Census of Drainage show that the agricultural drained land in the U.S. is estimated to total over 105 million acres. Illinois, the leading State, had 9.7 million acres drained. Approximately 10% of the total land in farms is estimated to be artifically drained or partially drained. Louisiana is the leading State in percentage of farmland drained, with 72% of its land in farms being drained. Regionally, drainage activity is concentrated in the North Central States which account for 49% of the drained land, followed by the South Central States which account for 27%. Other highly drained areas include Florida, the coastal areas of North Carolina and South Carolina, the Central Valley area of California, Delaware, and the Eastern Shore counties of Maryland. The 1977 Census of Governments classified total of 2,254 local government units in 29 states as special drainage districts apparently are inactive. Present expectations are that most new drainage will be confined to on-farm practices to improve existing cropland and for some conversion of wet soils in forest or pastureland to cropland. Project drainage is expected to be limited to maintenance and renovation of existing systems. (Moore-SRC)
W82-04069

RESERVOIR OPERATION FOR WATER CONSERVATION,
Texas Univ. at Austin. Center for Research in Water Resources.
For primary bibliographic entry see Field 3B.
W82-04165

OPTIMAL CONTROL OF RESERVOIR DISCHARGE QUALITY THROUGH SELECTIVE WITHDRAWAL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W82-04204

A DECOMPOSITION METHOD FOR THE LONG-TERM SCHEDULING OF RESERVOIRS IN SERIES,
Hydro-Quebec, Varennes.
For primary bibliographic entry see Field 6A.
W82-04205

OPTIMAL OPERATION OF A RESERVOIR SYSTEM USING FORECASTS,
Purdue Univ., South Bend, IN.
H. Yazicigil.
PhD Thesis, December, 1980. 240 p, 74 Fig, 29 Tab, 44 Ref, 2 Append, University Microfilms International, Ann Arbor, MI; Order No GAX81-13779.

Descriptors: *Model studies, *Mathematical models, *Water management, *Reservoir operation, Flood control, Recreation, Low-flow augmentation, Forecasting, Multipurpose reservoirs, *Green River Basin, Kentucky.

This study concerns the optimal operation of an existing multipurpose multireservoir system using forecasts. An optimization-simulation model was constructed for a system of four flood control reservoirs in the Green River Basin, Kentucky, having recreation and low-flow augmentation as secondary objectives. The resulting model, called GRBOSM, is designed for use in real-time as well as in long-term operations studies. The development of the operating policy component involved an investigation of goals and priorities for reservoir operation. The use of GRBOSM model in long-run reservoir operations studies has been demonstrated; system's responses under various operating and hydrologic conditions were obtained. The use of GRBOSM in real-time operations has been discussed also. It involves the use of forecast data during an operating horizon and the sensitive analyses of operating decisions with respect to changes in those forecasts. The GRBOSM model, besides being computationally efficient, is flexible to allow the examination of the operation of a complex reservoir-river system for a variety of operational policies. Specific to the approach in designing the GRBOSM algorithm is that penalty weights and target levels and zones are among the input variables for each time step. This provides for the flexibility needed in real-time operations. (Sinha, OEIS)
W82-04209

HYDROLOGIC EFFECTS OF THE FLOOD ABATEMENT PROGRAM IN SOUTHWESTERN OKLAHOMA,
Science and Education Administration, Chickasha, OK.
R. R. Schoof, W. O. Thomas, and W. M. Boxley.
Water Resources Bulletin, Vol 16, No 2, p 348-352, April, 1980. 6 Fig, 1 Tab, 5 Ref.

Descriptors: *Reservoirs, *Flood control, Flood protection, Hydrographs, Flood hydrographs, *Oklahoma, Channels, Runoff, Sedimentation, Sediment transport, Watershed management, *Erosion control, *Hydrologic budget.

The water budget of one of the nine impoundments established on Winter Creek as part of the Washita Flood Abatement Program is discussed. Consideration is also given to the effects of the Winter Creek flood abatement program on peak flows, channel regime, and base flow. The Winter Creek watershed lies in the Red Bed Plains subdivision of Central Lowlands physiographic province. The topography is rolling and sharply dissected. Soils include soft sandstone, siltstone, and shale for 92% of the watershed. The other 8% is alluvium along the main channels. Climate of the watershed is subhumid, with annual precipitation from 1963 through 1977 ranging 19.3 to 43.0 inches and averaging 28.9 inches. Application of a hydrologic model to the flood peaks indicated that the structural treatment reduced the flood peaks an average of 61%. The Winter Creek channel has narrowed and deepened since the structural treatment was applied. The severe bank erosion occurring before treatment has been arrested, and sediment yield from the watershed has been reduced 50 to 60%. In some reaches of the channel there has been a dense growth of trees in recent years. (Baker-FRC)
W82-04225

LAKE LEVEL DRAWDOWN AS A MACROPHYTE CONTROL TECHNIQUE,
Kent State Univ., Kent, OH. Dept. of Biological Sciences.
G. D. Cooke.
Water Resources Bulletin, Vol 16, No 2, p 317-322, April, 1980. 2 Tab, 30 Ref.

Descriptors: *Drawdown, *Macrophytes, Eutrophication, *Lakes, Water quality, Recreation, Water management, Lake restoration, *Water level, *Water quality control, Case studies, Hydrologic budget.

Case histories are described in which lake level drawdown was used as a macrophyte control technique. Macrophyte species which are susceptible, resistant, or do not change after a summer, winter, or whole year drawdown are listed; an evaluation is made on the technique; and recommendations are made for its use and further research. The case histories presented were selected from Murphy Flowage, Wisconsin; Mondeaux Flowage, Wisconsin; and Louisiana reservoirs. These case histories suggest that the technique may be species specific, for example for Potamogeton robinsii; that the invasion of resistant species such as Najas flexilis may be rapid; and that undesirable changes may occur in the system, including algal blooms and low dissolved oxygen. The technique appeared successful, at least for short term control of 1 to 2 years. It can achieve control at relatively low cost without the introduction of chemicals or use of machinery. There is insufficient information to determine whether a summer or a winter drawdown will be most effective, but freezing to kill reproductive structures apparently requires a deep frost, which may not occur with heavy snow cover or with the milder, rainy winter which is found in large portions of the most macrophyte-impacted areas of the United States. It is apparently essential to achieve dewatering of the sediments, which can be difficult where seepage represents a significant portion of the water budget. This points out the need for determining a water budget before drawdown. (Baker-FRC)
W82-04235

STORM WATER MANAGEMENT: THE CONCEPT AND ITS APPLICATION,
Georgia Inst. of Tech., Atlanta.
T. N. Debo.
Water Resources Bulletin, Vol 16, No 4, p 654-660, August, 1980. 3 Fig, 3 Tab, 5 Ref.

Descriptors: *Storm water, *Urban planning, *Flood control, Urban drainage, Urban hydrology, Columbus, Georgia, Water management, Hydrologic models, Planning, Erosion, Sedimentation, Alternative planning.

Storm water management is defined as the process of controlling storm runoff from the land surface through a combination of structural and nonstructural drainage and flood control measures. Columbus, Georgia, has developed a $200,000 storm water management program which includes soils inventory and analysis, hydrologic data collection, sedimentation and erosion control, storm water management handbook, urban flood simulation model, interdepartment coordination study, drainage problem categorization study, and a pilot basin study of the 1.3 sq mile Holly Hills Basin. The city is evaluating 6 alternatives obtained from the Holly Hills study. (Cassar-FRC)
W82-04240

EFFECT OF URBANIZATION ON ALTERNATIVE FLOOD CONTROL STRATEGIES,
Dames and Moore, Houston, TX.
For primary bibliographic entry see Field 4C.
W82-04244

ENVIRONMENTAL IMPACT OF CHANNEL MODIFICATION,
Science and Education Administration, Chickasha, OK.
R. Schoof.
Water Resources Bulletin, Vol 16, No 4, p 697-701, August, 1980. 21 Ref.

Descriptors: *Channel improvement, *Flood control, *Environmental effects, Reviews, Channel erosion, Dredging, Erosion, Silting, Streams, Sedimentation, Flooding, Dikes, Fish, Invertebrates, Aquatic life.

The effects of channelization and the feasibility of alternative methods of flood control are reviewed. During the past 150 years over 200,000 miles of streams have been modified by widening, deepening, and straightening the channels for the purposes of flood control, wetlands drainage, and water transport. Channelization alters the environment in several ways: draining wetlands, cutting off oxbows and meanders, clearing hardwood trees from the floodplains, lowering the water table, reducing groundwater recharge from streamflow, and increasing erosion, sedimentation, channel maintenance, and downstream flooding. Channelization may disturb fish size, number, and species diversity for up to 10 years in a wet climate and indefinitely in drier climates. Although channelization has been an effective flood control measure in the immediate area of the project, downstream flooding and silting have generally been more severe, especially in channels dredged through noncohesive material. Eight steps for evaluating the benefits and environmental effects of channelization programs are given. Dikes are suggested as an alternative to channelization for flood control. Other solutions are a variety of structural controls, adjusting the use of floodplains to minimize damage, and a combination of the two. Since 1970 very few channels have been modified because the required planning process has become very cumbersome. (Cassar-FRC)
W82-04245

WATER QUALITY TRAP EFFICIENCY OF STORM WATER MANAGEMENT BASINS,
Maryland Univ., College Park. Dept. of Civil Engineering.

For primary bibliographic entry see Field 5G.
W82-04248

4B. Groundwater Management

MULTI-ATTRIBUTE DECISION ANALYSIS FOR THE PROTECTION OF GROUNDWATER RESOURCES,
Texas Univ. at San Antonio. Div. of Environmental Studies.
For primary bibliographic entry see Field 6A.
W82-03805

POTENTIAL IMPACT OF GROUND WATER POLICY ALTERNATIVES ON NEBRASKA AGRICULTURE, 1977-2020,
Nebraska Univ.-, Lincoln.
For primary bibliographic entry see Field 6B.
W82-03826

A LEGAL-ECONOMIC CRITIQUE OF GROUNDWATER LAW AND ADMINISTRATION: WITH SPECIAL REFERENCE TO ARIZONA AND NEBRASKA,
Nebraska Univ., Lincoln.
For primary bibliographic entry see Field 6E.
W82-03827

EXPERIENCE WITH BOREHOLE RECHARGE IN THE LEE VALLEY,
Thames Water Authority (England).
R. J. E. Hawnt, J. B. Joseph, and R. J. Flavin.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 5, p 437-451, September, 1981. 5 Fig, 2 Tab, 17 Ref.

Descriptors: *Artifcial recharge, *Aquifers, *Groundwater management, Water storage, Drought, Water supply, Water supply development, Lee Valley, *United Kingdom.

Since the 1890s, experimental artificial groundwater recharge has been carried out in the Lee Valley. The purpose has been to utilize the dewatered storage capacity in the aquifer caused by over-abstraction. The prototype scheme as described in this paper was designed to test the feasibility of groundwater augmentation by artificial recharge under full-scale operational conditions. Thirteen wells and boreholes were used, with a nominal recharge capacity of 90 Ml/d and abstraction capacity of 80 Ml/d. Tthe additional drought yield provided by the scheme is estimated to be 60 Ml/d for a 150 day period. Detailed observation of one complete cycle of recharge and abstraction showed that virtually all of the dewatered storage was available for recharge. Some effects on groundwater quality were noted at two sites, but these were localized, and periodic analysis of samples suggests that the effects were only temporary and that no permanent damage was done. The Lee Valley artificial recharge scheme is the first major operational recharge scheme in the United Kingdom. The extra water thus stored can be used for the augmentation of supplies during periods of drought. Still greater potential for groundwater storage exists in the rest of the Lee Valley region. The capital costs of constructing a large scale artificial recharge scheme for groundwater storage in the Lee Valley are only about the third of the cost of constructing a surface storage reservoir with a similar yield, but the operating costs are greater. (Baker-FRC)
W82-03894

MANAGEMENT OPTIONS FOR GROUND WATER IN URBANIZING AREAS,
Tetra Tech, Inc., Lafayette, CA.
K. V. Summers, G. L. Rupp, and S. A. Gherini.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-198052, Price codes: A07 in paper copy, A01 in microfiche. US Department of the Interior, Washington, DC, December, 1981. 113 p, 51 Fig, 9 Tab, 43 Ref. OWRT-C-00034-U(0505)(1). 14-34-0001-0505.

Descriptors: *Groundwater pollution, *Groundwater management, *Urbanization, Groundwater recharge, Water pollution control, Groundwater depletion, Long Island, New York, Massachusetts, Spokane aquifer, Washington, San Bernardino area, California.

Urbanization can cause decreased recharge to ground water, decreased baseflow to streams, and contamination of surface and ground water. This project investigated the effects of urbanization and the results of implementing various ground-water management approaches. Four example areas encompassing different hydrogeologic conditions, land uses, and management approaches were selected. The areas studied were Suffolk County, Long Island; southeastern Massachusetts; the Spokane aquifer, Washington; and the San Bernardino area, California. Problems investigated included aquifer contamination from organic chemicals, nitrates, sodium, and other inorganic pollutants; declining water levels; and effects of artificial recharge programs. Based on the findings from the four areas, technical factors influencing the susceptibility of ground water to contamination and the likelihood of water supply problems were identified (e.g. aquifer characteristics, unsaturated zone characteristics, recharge rate). A procedure for selecting feasible management methods to protect the ground water was designed based on these factors. By selecting management approaches uniquely suited to a particular area, problems may be avoided or minimized and priorities set based on the sensitivity of the aquifer to contamination from a wide variety of waste sources.
W82-03961

GROUND-WATER HYDROLOGY OF THE MORMON ISLAND CRANE MEADOWS WILD-LIFE AREA, NEAR GRAND ISLAND, HALL COUNTY, NEBRASKA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-03991

NITROGEN AND PHOSPHORUS CONTENT OF FLOW FROM DRAINS FERTILIZED WITH COW MANURE SLURRY,
Macdonald Coll, Montreal (Quebec).
For primary bibliographic entry see Field 5B.
W82-04183

4C. Effects On Water Of Man's Non-Water Activities

IMPACTS OF SURFACE DRAINAGE ON GROUND WATER HYDRAULICS,
Louisiana State Univ., Baton Rouge. Dept. of Marine Sciences.
F. C. Wang, and A. R. Overman.
Water Resources Bulletin, Vol 17, No 6, p 971-977, December, 1981. 6 Fig, 2 Tab, 21 Ref.

Descriptors: *Water table decline, *Drainage effects, *Canals, Channels, Runoff, Soil water, Subsurface runoff, Surface runoff, Drawdown, Urbanization, *Florida, Model studies, Wetlands, Marshes, Swamps, Aquifers, Groundwater recharge, Recharge, *Surface-groundwater relations.

A surface model and a groundwater model are combined to estimate the impact of drainage canals on water table drawdown in south Florida wetlands. The surface runoff model is formulated on the climatic water balance technique, and the groundwater model is treated as a one-dimensional transient phenomenon that forms a nonlinear flow problem. In this flat region canals are the prime cause of depletion in groundwater storage. Drainage canals have changed the natural surface flow pattern and have increased the amount of sheet flow by 50% over the pre-canal conditions. There is a direct hydraulic connection between canals and the shallow limestone aquifer, which is within 10 ft of the surface. Overdrainage from the canal system has generally lowered the water table, for example, 1.5-2 ft in the Fahka Union Canal Watershed at a distance of 1 mile from the canal. The ecosystem has been altered even at considerable distances from the canal. This drainage system favors point discharges over sheet discharge and possible increased contamination of the receiving estuary. (Cassar-FRC)
W82-03753

URBAN RAINFALL-RUNOFF MODELLING USING REMOTE SENSING IMAGERY,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-03820

ON A TECHNIQUE TO INVESTIGATE THE COVARIATION BETWEEN STREAMFLOW AND RAINFALL IN AFFORESTED CATCHMENTS,
University of the Witwatersrand Univ., Johannesburg (South Africa).
T. G. J. Dyer.
Ecological Modelling, Vol 13, No 3, p 149-157, August, 1981. 2 Fig, 5 Tab, 6 Ref.

Descriptors: Streamflow, Rainfall, *Forest hydrology, Soil-water-plant relationships, Pinus patula, Eucalyptus, *Rainfall-runoff relationships, Trees, *South Africa.

The effect of afforestation on streamflow was analyzed using principal components analysis. Three catchments were planted in South Africa, as follows: (a) Eucalyptus gradis, (b) Pinus patula, and (c) control, no trees planted. The study covered 1956 to 1977, with up to 1969 as a control period. Most of the variation in streamflow was associated with rainfall in the Pinus patula forest and in the control area. An anomalous stream in the Eucalyptus area made conclusions difficult, but subjective evaluations suggested that streamflow decreased with time. P. patula is the more desirable tree to plant except in swampy land, where Eucalyptus may be better. (Cassar-FRC)
W82-03864

PROGRESS REPORT ON THE EFFECTS OF SURFACE MINING ON THE SURFACE-WATER HYDROLOGY OF SELECTED BASINS IN THE FORT UNION COAL REGION, NORTH DAKOTA AND MONTANA,
Geological Survey, Bismarck, ND. Water Resources Div.
D. G. Emerson.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $4.25, Microfiche $3.50. Geological Survey Open-File Report 81-678, June, 1981. 28 p, 6 Fig, 7 Tab, 11 Ref.

Descriptors: *Strip mining, *Surface water, *Mine drainage, Water pollution effects, Computer models, Coal mining, Hydrologic cycle, Land use, Data collections, Water analysis, Water quality, Precipitation, Runoff, *North Dakota, *Montana, Fort Union Coal Region, *Environmental effects, Rainfall-runoff relationships.

The purpose of the investigation is to provide a means to assess the impacts on surface-water hydrology due to changes in land use resulting from surface mining of coal in the Fort Union Coal Region, North Dakota and Montana. The objectives of the study are to: (1) Determine premining hydrologic conditions in small representative drainage basins and provide historical data with which to compare the magnitude of changes resulting from mining, and (2) develop the capability of making reasonably accurate projections of hydrologic effects resulting from the various land-use changes caused by surface mining. Data collection has been underway since October 1976 for the West Branch Antelope Creek study area in western North Dakota and since March 1978 for the Hay Creek study area in eastern Montana. Data collected during the premining period are being analyzed using statistical methods for the evaluation of the premining conditions. A digitial model with the capability of making hydrologic projections is being developed. Most of the model components have been tested during 1979 and 1980. (USGS)
W82-03975

INFLUENCE OF FOREST AND RANGELAND MANAGEMENT ON ANADROMOUS FISH HABITAT IN WESTERN NORTH AMERICA; 8. EFFECTS OF MINING,
Intermountain Forest and Range Experiment Station, Boise, ID.
For primary bibliographic entry see Field 5C.
W82-04071

INFLUENCE OF FOREST AND RANGELAND MANAGEMENT ON ANADROMOUS FISH HABITAT IN WESTERN NORTH AMERICA; 7. EFFECTS OF LIVESTOCK GRAZING,
Intermountain Forest and Range Experiment Station, Boise, ID.
For primary bibliographic entry see Field 5C.
W82-04072

THE NORTH CAROLINA SEDIMENTATION CONTROL PROGRAM--AN ASSESSMENT,
North Carolina Water Resources Research Inst., Chapel Hill.
For primary bibliographic entry see Field 2J.
W82-04160

EFFECT OF URBANIZATION ON ALTERNATIVE FLOOD CONTROL STRATEGIES,
Dames and Moore, Houston, TX.
R. C. Bost, P. B. Bedient, and P. G. Rowe.
Water Resources Bulletin, Vol 16, No 4, p 710-716, August, 1980. 5 Fig, 5 Tab, 25 Ref.

Descriptors: *Urbanization, *Flood control, *Urban watersheds, Urban hydrology, Land use, Flood plain management, Hydrologic models, Model studies, *Cypress Creek, *Texas, Channel improvement, Watershed management, Detention reservoirs, Reservoirs, Levees.

Model studies of the 320 sq mile rapidly developing Cypress Creek watershed, near Houston, Texas, produced double-peaked hydrographs for a 12.3 inch 100-year rainfall event for the years 1976, 1983, and 1990. Hydrograph peaks were earlier and higher as the degree of urbanization increased. The second peak, about 2 days after the first, must be considered in design of watershed management procedures to avoid coinciding with rural runoff. Several flood control alternatives were examined for the Cypress Creek using the Corps of Engineers HEC-1 Flood Hydrograph and HEC-2 Water Surface Profile models. Flood control alternatives considered were channelization and levee construction, a flood control reservoir, controls on urban development, detention storage, and combinations of the above. The most effective alternative was a combination of channel modification to convey a 100-year flood, locating a reservoir on Little Cypress Creek, and using on-site detention for future development. These measures would reduce 1983 and 1990 100-year flood peaks by 12-18% in the upper watershed and 20-25% in the lower watershed. (Cassar-FRC)
W82-04244

4D. Watershed Protection

WATERING AUSTRALIA'S DRIEST STATE,
University of Strathclyde, Glasgow (Scotland).
For primary bibliographic entry see Field 6D.
W82-03767

HYDROLOGIC EFFECTS OF THE FLOOD ABATEMENT PROGRAM IN SOUTHWESTERN OKLAHOMA,
Science and Education Administration, Chickasha, OK.
For primary bibliographic entry see Field 4A.
W82-04225

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

EVALUATION OF FOUR CONCENTRATION/EXTRACTION PROCEDURES ON WATERS AND EFFLUENTS COLLECTED FOR USE WITH THE SALMONELLA TYPHIMURIUM SCREENING PROCEDURE FOR MUTAGENS.
Canada Centre for Inland Waters, Burlington (Ontario).
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 6, p 758-764, December, 1981. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Water quality, *Water pollution control, Environmental protection, *Pollutant identification, *Mutagens, Effluents, Monitoring, Membrane processes, Membranes, Membrane filters.

Four concentration/extraction procedures: solvent extraction, adsorption onto XAD resins, flash evaporation and membrane filtration (MF), were compared for their ability to concentrate and extract potential mutagens from river, lake and effluent samples. A total of 33 water samples were collected for mutagen content assessment. No single extraction/concentration technique proved uniquely sensitive to all potential mutagenic agents found in the samples tested. If one procedure had to be chosen the membrane filtration of flash evaporated samples would be the most likely. It was inexpensive, with $5.00 covering disposables and labor for single-time MF samples and about $10.00 for the ten-fold flash evaporated sample which was then membrane filtered. It is possible to make the membrane filter concentration procedure more effective by filtering a larger volume of sample, but toxicity to tester strains may increase. Based on the findings of this study, a quick inexpensive screening procedure for mutagenic activity is available as part of the battery approach by using the membrane filtered 10X flash evaporated samples and IX natural samples combined with S. typhimurium tester strains TA98 and Tal538 with the routine incorporation of S-9 mix. It is suggested, however, that the solvent extraction procedure be used as well until enough data are collected to confirm the validity of the membrane filter concentration practice. (Baker-FRC)
W82-03775

EFFECT OF WATER TREATMENT ON MUTAGENIC POTENTIAL,
Jardine Water Purification Plant, Chicago, IL.
E. P. Flanagan, and H. E. Allen.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 6, p 765-772, December, 1981. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Water treatment, *Quality control, Drinking water, Potable water, Public health, Water quality, *Monitoring, *Salmonella, *Mutagens, Lake Michigan, Calumet River, Fox River, Illinois.

Water samples were taken from Lake Michigan, the Calumet River, and the Fox River and analyzed for mutagenic potential by the Ames Test. The samples representing the Lake Michigan water source were collected within the Jardine Water Purification Plant of Chicago. Two Lake Michigan samples produced a response from unactivated compounds with Salmonella test strain TA1538, which indicates the presence of mutagenic compounds as well as a change in response that may be attributable to treatment of the water. The mutagenic activity ratio, which expresses the mutagenic activity as a ratio between the experimental counts and the negative control count, increased for the completely treated potable water. Concentrates of the Calumet River water to which chlorine were added produced more revertants per volume of concentrate than did the concentrates of water which had not been chlorinated. Chlorination of the water with no additional treatment produced the highest degree of activity. Treatment with coagulants for the Calumet River samples reduced the net number of revertants to one-third the value for the raw water. The addition of chlorine as the final treatment step increased the net number of revertants by a factor of ten. (Baker-FRC)
W82-03776

THE EVALUATION OF THE ELUTRIATE TEST AS A MEANS OF PREDICTING THE BEHAVIOR OF SELECTED CHLORINATED HYDROCARBONS IN DREDGED SEDIMENT DURING OPEN-WATER DISPOSAL,
Texas Univ. at Dallas, Richardson.
J. S. Butler.
PhD Thesis, August 1981. 216 p, 40 Fig, 57 Tab, 94 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No. GAX81-26591.

Descriptors: *Waste disposal, *Spoil banks, *Chlorinated hydrocarbons, Polychlorinated biphenyls, Pesticides, Sediments, Testing procedures, Water pollution, Dredging, *Pollutant identification, *Elutriate test, Dredged sediments.

The elutriate test, designed by the US Army Corps of Engineers (COE) and the U.S. Environmental Protection Agency (EPA), consists of vigorously mixing one part sediment with four parts water for 30-minutes. After one-hour settling, the supernatant (the elutriate) is either filtered or centrifuged and the elutriate analyzed for the parameters of interest. The purpose of this investigation is to study the applicability of the elutriate test for certain chlorinated hydrocarbons. The compounds studied were polychlorinated biphenyls and the following chlorinated hydrocarbon pesticides: DDT and its analogs DDE and DDD, as well as aldrin, dieldrin, lindane, heptachlor, methoxychlor, mirex and both isomers of endosulfan. The validity of the elutriate test as a predictive tool was examined by monitoring several dredged material disposal operations. Results showed that the elutriate test is a viable tool for determining immediate, short-term effects of chlorinated hydrocarbons on the water column. Through statistical analyses, it was found that the total organic carbon content in the elutriate and water column is a good indicator of release or sorption of the chlorinated hydrocarbons. (Sinha-OEIS)
W82-03824

A RESUME OF THE KINETICS OF THE BOD TEST,
T. Stones.
Water Pollution Control, Vol 80, No. 4, p 513-520, 1981. 11 Fig, 5 Tab, 21 Ref.

Descriptors: *Biological oxygen demand, *Kinetics, *Heavy metals, *Wastewater analysis, Nitrification, Oxidation, Ammonia, Pollutant identification, Metals, Toxicity, Lead, Copper, Nickel, Cadmium, Chromium, Zinc, Silver, Mercury, *Wastewater facilities.

Oxidation of sewage components occurs in 2 stages: first, oxidation of carbonaceous matter (15-20 days) and second, oxidation (or nitrification) of ammonia. There is an overlap between stages. Phelps' law states that the rate of oxidation of carbonaceous matter at any instant during the first stage is proportional to its unsatisfied BOD, a first-order reaction. A plot of BOD for a 1/100 dilution of settled domestic sewage against time showed that the 5-day BOD test at 20C represented 73.8% of the total. Experimental data did not fit either a first-order equation or a first-order equation modified with a retardation factor. It was concluded that during the first 10 days oxidation proceeds according to a second-order reaction and that the nitrification stage begins before it is apparent. The toxicity of Pb, Cu, Ni, Ni, Cr, Cd, Zn, Ag, and Hg salts to the biochemical oxidation process in sewage was evident. The curves of satisfied biochemical oxygen demand vs. days for sewage with added metal ions showed an initial lag, a period of increasing oxidation rate, and decrease in oxidation rate, giving a sigmoid curve. The curve obtained with nontoxic sewage was smooth, showing initial rapid oxidation rates which gradually declined. Although undue concentrations of toxic matter in

sewage can mask the true amounts of oxidizable material present, the metal levels found in most sewage have minimal effects on first-stage oxidation. (Cassar-FRC)
W82-03832

SEWAGE-TREATMENT WORKS' EFFLUENT SAMPLING--HAVE OUR MEANS ANY MEANING,
J. A. Garry, C. J. Moore, and B. D. Hopper.
Water Pollution Control, Vol 80, No 4, p 481-489, 1981. 7 Fig, 5 Tab, 1 Ref.

Descriptors: *Sampling, *Oxygen demand, Monitoring, Effluents, *Pollutant identification, Diurnal distribution, Statistical analysis, *Wastewater facilities, *England.

Total oxygen demand (TOD) was measured with a Philips type PW 9625 meter at the Countess Wear sewage treatment works in England to determine the reliability of sampling. Flow and TOD were continuously monitored from January 17 to March 22, 1977, producing over 2200 TOD values. Analysis of data indicated that the TOD followed a well-defined diurnal pattern on all 7 days of the week. TOD values differed from the mean by as much as -35% at 1150 hours to +26% at 1950 to 1950 hours. Mondays, the TOD values were below average in the a.m. and above average in the p.m. hours. TOD values on Tuesdays were above average all day, on Wednesday through Fridays were average, and on Saturdays and Sundays, below average. As a result of this variability a spot TOD sample would differ from the mean value by 10% on 4 of 5 occasions. Samples taken at 430 hours of 1600 hours would be closest to the mean. Spot sampling done during hours of lower TOD (minimum at 1150 hours) would indicate that the plant is producing a better effluent than the daily mean indicates. (Cassar-FRC)
W82-03833

ROLE OF SENSORS IN TRUNK SEWERS IN THE CONTROL OF FLOW AND WASTEWATER QUALITY,
Hitachi Ltd., Kawasaki (Japan). Systems Development Lab.
For primary bibliographic entry see Field 5D.
W82-03859

EPA'S PRIORITY POLLUTANTS: WHERE THEY COME FROM--WHERE THEY'RE GOING,
Radian Corp., Austin, TX.
For primary bibliographic entry see Field 6E.
W82-03875

METHOD OF SELECTIVE DISSOLUTION FOR CHARACTERIZATION OF PARTICULATE FORMS OF RADIUM AND BARIUM IN NATURAL AND WASTE WATERS,
Ceske Vysoke Uceni Technicke v Praze. Dept. of Nuclear Chemistry.
P. Benes, J. Sedlacek, F. Sebesta, R. Sandrik, and J. John.
Water Research, Vol 15, No 12, p 1299-1304, December, 1981. 1 Fig, 5 Tab, 9 Ref.

Descriptors: *Analytical techniques, *Mine wastes, *Wastewater, Mine drainage, Drainage, Selectivity, Precipitation, *Barium, *Radium, Uranium, *Pollutant identification.

Characterization of particulate forms of radium and barium in natural and waste waters is described. The method used is selective dissolution, which consists in successive washing of the solid phase, separated from natural or waste water, with a series of suitable chosen solutions (selective solvents) and analysis of the eluates. Each solution, used selectively, dissolves more or less clearly defined forms of the trace element in question, and therefore the content of the trace element in the eluate characterizes the abundance of the corresponding forms in the solid phase. In the experiments, particulate solids suspended in 1 to 3 liters of water were first concentrated by membrane filtration or by centrifugation to 20-50 ml of a concentrate, which was then filtered through a small sized membrane filter. The solids retained by bound, acid soluble, and sulfate bound forms of radium and barium. Compositions and volumes of the selective solvents have been chosen using model experiments and partially checked by analysis of natural samples. Radium and barium in crystalline detritus remain on the filter and are determined after an acid digestion of the filter. The principle criteria and the selectivity of the method are discussed. While there is little doubt that the procedure has some imperfections mainly due to the imperfect selectivity of the dissolution, in practice the analytical errors will be lower than the errors which can be inferred from the model experiments. (Baker-FRC)
W82-03879

GAS CHROMATOGRAPHIC TECHNIQUES FOR CONTROLLING ORGANICS REMOVAL PROCESSES,
Municipal Environmental Research Lab., Cincinnati, OH.
A. A. Stevens, D. R. Seeger, C. J. Slocum, and M. M. Domino.
Journal of the American Water Works Association, Vol 73, No 10, p 548-554, October, 1981. 19 Fig, 1 Tab, 4 Ref.

Descriptors: *Water treatment, *Monitoring, Organic compounds, *Gas chromatography, *Drinking water, Chromatography, Evaluation.

This paper focuses on organic chemicals as indicators for controlling drinking water treatment unit processes, specifically those that can be measured by gas chromatographic techniques. The suitability of gas chromatography for the lower-molecular-weight volatile end of the organics spectrum, which includes synthetic organic chemicals, can be exploited by the use of gas chromatograph/flame ionization detector organics profiles for evaluating treatment processes designed for removal of these chemicals. Three generalized examples are offered which summarize the use of GC/FID profiles for evaluating organics removal unit processes. First, the apparent concentration of an individual compound in the granular activated carbon (GAC) influent may have wide variations. However, the variation in effluent concentration may be less than that of the influent. Beyond a certain time, areas under the two curves should be about equal. Second, the subjective overall visual impressions gained from the GC organics profiles can still be used to evaluate GAC effectiveness, even acknowledging variations in individual compounds. Effluent profiles nearly always show improvement in comparison to influent profiles when the overall impression is considered. This is in contrast to the observation for individual compounds. Finally, although GC profiles are well suited for comparisons for evaluation of treatment process components, more specific methods of analysis are needed to determine absolute water quality. (Baker-FRC)
W82-03888

LIMITATIONS OF STANDARD COLIFORM ENUMERATION TECHNIQUES,
Oregon State Univ., Corvallis. Dept. of Microbiology.
R. J. Seidler, T. M. Evans, J. R. Kaufman, C. E. Warvick, and M. W. LeChevalier.
Journal of the American Water Works Association, Vol 73, No 10, p 538-542, October, 1981. 5 Tab, 19 Ref.

Descriptors: *Drinking water, *Coliforms, *Monitoring, Water quality, Human diseases, Public health, Surface waters, Wells, *Disinfection, Chlorination, Filters, Membrane filters, Membrane processes, Membranes, Fermentation.

Data are presented on two new fermentation tube techniques developed to detect coliforms in drinking water. A tube-by-tube analysis of the data is used to document steps in the standard MPN procedure that are prone to failure in the detection of coliforms. The impact of verification media on the detection of coliforms by the MF technique is also presented, as are the identifications of coliforms isolated by the different procedures. The results suggest that the efficiency of coliform detection can be significantly increased by simple, economical variations in current methodology. Drinking water samples were collected over a 24 month period from several municipal water supplies in western Oregon. The majority of coliform-positive samples were collected from one Oregon coastal community that used two surface waters as the raw water source and practiced no treatment other than chlorination. Other positive samples were collected from western Oregon valley communities that use well water and do not practice treatment or disinfection. The results demonstrated the shortcomings of the standard fermentation tube and MF techniques in detecting coliforms in potable water supplies. An alternative method for routine water analysis that uses currently available media, incubation times, and temperatures as well as a familiar technique appears to achieve superior coliform recovery. (Baker-FRC)
W82-03889

NOTES AND COMMENTS: LEACHING OF ORGANICS FROM A PVC-POLYETHYLENE-PLEXIGLASS PILOT PLANT,
Montgomery (James M.), Inc., Pasadena, CA.
For primary bibliographic entry see Field 5F.
W82-03890

PROCEDURE FOR EVALUATING THE GEOLOGIC INTEGRITY OF EXISTING HAZARDOUS WASTE SITES IN LOUISIANA: CASE HISTORIES,
Geological Survey, Baton Rouge, LA.
B. C. Hanson.
In: Fourth Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 28-30, 1981. p 417-424, 1981. 1 Fig. Department of Engineering & Applied Science, University of Wisconsin--Extension, Madison, WI.

Descriptors: *Groundwater pollution, *Hazardous materials, *Water quality control, Toxins, *Waste disposal, Land disposal, Public participation, Public hearings, Public policy, State jurisdiction, Evaluation, Hydrogen sulfide, Plumes, Aquifer characteristics, Case studies, *Louisiana.

Two previously permitted, commercially operated, hazardous waste disposal sites in Louisiana are under investigation for possible contamination of the underlying fresh water aquifers. Both are engaged in landfarm and landfill activities; one has an operational Class I injected well. An additional rural residential area was included in the study after numerous complaints were filed with state authorities. A three-phase procedure is described that determines the nature of the problem, evaluates existing geologic and hydrologic data, and uses the results to initiate corrective action, if required. Public hearings were held regarding each of the facilities, door-to-door interviews were conducted, and a library search of hydrologic and geologic information was made. A mapping program was established to correlate the various shallow alluvial and deltaic deposits around each hazardous waste site. The results of the literature search revealed the existence of many natural processes at work in the subsurface; many could account for the reported problems with water quality. Further data analysis is needed. Other preliminary results indicate that some of the water problems reported by residents are probably unrelated to the waste facilities. The major complaint of the definite smell or taste of hydrogen sulfide appears widespread throughout southern Louisiana and occurs where there are no hazardous waste sites. Waste plumes originating from each facility could be intercepted by residential water wells, but the existence of such plumes has yet to be determined. (Garrison-Omniplan)
W82-03932

IMPROVING THE RELIABILITY OF GROUND-WATER MONITORING AT INDUSTRIAL WASTE DISPOSAL FACILITIES,
Engineering-Science, Inc., Atlanta, GA.
J. R. Absalon.
In: Fourth Annual Madison Conference of Applied Research & Practice on Municipal & Industrial

Waste, September 28-30, 1981. p 383-392, 1981. 1 Fig, 13 Ref. Department of Engineering & Applied Science, University of Wisconsin--Extension, Madison, WI.

Descriptors: *Monitoring, *Groundwater flow, *Industrial wastes, *Aquifers, Hydrology, Carbonate aquifers, Hydrologic models, Boreholes, Groundwater movement, Groundwater contamination, Hydraulic gradient, Wastewater discharge, Planning, Resistivity.

The Resources Conservation and Recovery Act has established minimal requirements for a groundwater quality monitoring system at hazardous waste disposal facilities. Four wells---one hydraulically up-gradient and three hydraulically down-gradient---must be placed to intercept contamination if present. A basic monitoring system can be severely limited if an owner-operator is unfamiliar with geoscientific principles governing the occurrence and movement of ground water. A basic system is also restricted in its capability to obtain subsurface data and to evaluate off-site complications. Hydrogeologic factors that complicate monitoring efforts include lithologic variations, multiple ground-water flow zones and carbonate or fractured systems. Two major planning aids for a monitoring system are non-site methods and site methods. The non-site methods are: (1) conceptual modeling, an estimation of ground water conditions expressed in three dimensions; (2) flow-system kinematics models, a two-dimensional depiction of flow path and arrival time of groundwater moving within an area; and (3) airborne remote sensing, usually by aerial photography. Site methods are: (1) drilling, which is applicable to most situations; (2) surface geophysical methods, consisting of electrical resistivity, ground penetrating radar, and electromagnetic conductivity; and (3) ground-water tracers using inert and organic and inorganic agents, dyes and fluorocarbons. There are many study aids and systems to design a ground-water quality monitoring system, and all of them should be used with other data sources to ameliorate the site-specific nature of ground-water monitoring. (Atkins-Omniplan)
W82-03940

A STUDY OF BIOTIC TRANSPORT OF ASBESTIFORM FIBERS IN LAKE SUPERIOR,
Michigan Technological Univ., Houghton. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W82-03950

DEVELOPMENT AND USE OF A CONTINUOUS TOC-MEASUREMENT DEVICE IN WASTEWATER PURIFICATION,
Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
A. Tiemon, and B. Wagner.
Water Science and Technology, Vol 13, No 9, p 211-216, 1981. 7 Fig.

Descriptors: *Wastewater treatment, *Purification, Measuring instruments, Water quality, Wastewater facilities, *Organic carbon.

The development of a total organic carbon (TOC) measurement device is described. The continuous TOC signal is used to improve the performance of the activated sludge process. This is achieved by monitoring and control efforts within the plant itself and in the sewerage system. Continuous measurement of TOC provides a fast and reliable method of characterizing fluctuations in the organic loading of waste water with a high industrial component. Measurement of TOC is more effective than other methods using parameters such as COD and BOD5. Tests of already existing TOC measuring units which are continuous-operation models showed that they were unsuitable for prolonged usage and required frequent service. Even instruments offered as automatic analyzers exhibited flaws in their operational performance. A monitoring and control system was thus developed for industrial dischargers. Using this system demonstration of increased concentration of organic or poisonous compounds in the waste water is possible. A controlled discharge was chosen at major industrial plants, where it is possible to achieve equalization of the residual load variations without large equalization basins. The control signal is calculated from the measurement of the TOC concentration, flow rate and residence time in the sewerage system. A comprehensive inventory of the discharge situation was made at key points in the sewerage system, and continuously operating monitoring stations were installed as container units. The effect of the control efforts on the purification process is supervised by monitoring the TOC in the influent and effluent of the sewage treatment plant. (Baker-FRC)
W82-04019

ELECTRON-CAPTURE GAS CHROMATOGRAPHIC DETERMINATION OF SULPHIDE AS A NEW PENTAFLUOROBENZYL DERIVATIVE,
Kaohsiung Medical Coll. (Taiwan). School of Pharmacy.
H. -L. Wu, K. Funazo, M. Tanaka, and T. Shono.
Journal of Chromatography, Vol 219, No 2, p 312-316, December, 1981. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Water analysis, *Sulfides, Chromatography, Measuring instruments, *Pollutant identification, Industrial wastes, *Gas chromatography.

A new approach is described for the quantitative analysis of inorganic sulfide down to ppb levels. The approach is based on detector-oriented derivatization of sulfide as bis(pentafluorobenzyl) sulfide. The method has been applied to the analysis of sulfide in spring water. The procedure called for the addition of a 0.5 ml volume of pentafluorobenzyl bromide to a 15 ml glass stoppered flask containing 0.1 ml of the reference standard or sample solution. The reaction mixture was magnetically stirred for 1 hr at room temperature and then evaporated under a nitrogen stream for 2 min at room temperature. To the concentrated solution, 1.0 ml of internal standard solution was added and mixed well, followed by a small pinch of anhydrous sodium slufate. The gas chromatographic determination was performed by injecting about 0.4 microliters of the clear toluene layer. The method did not suffer interference from acetate, sulfite, sulfate, chloride, carbonate, thiosulfate, cyanide, nitrate and nitrite at levels found in environmental samples. In the analysis of sulfide in spring water the results compared favorably with those obtained by a colorimetric method based on methylene blue formation. The method was specific and highly sensitive. (Baker-FRC)
W82-04036

SPECIATION OF TRACE DI- AND TRIORGANOTINS IN WATER BY ION-EXCHANGE HPLC-GFAA,
National Bureau of Standards, Washington, DC.
K. L. Jewett, and F. E. Brinckman.
Journal of Chromatographic Science, Vol 19, No 11, p 583-593, November, 1981. 9 Fig, 5 Tab, 37 Ref.

Descriptors: *Water analysis, *Trace metals, Tin, Organotin compounds, Industrial wastes, Water pollution sources, *Pollutant identification, *Wastewater, Effluents.

Direct high performance liquid chromatography (HPLC)/graphite furnace atomic absorption (GFAA) speciation demonstrates an effective means for field monitoring of aqueous effluents before and after biological treatment by sludge or sanitary digestion/disposal units serving shipyards and other operations employing organotin biocides. Optimization of the strong cation-exchange (SCX) column parameters was characterized in terms of efficiency and resolution, to provide examples for separation of organotins by class, functionality, and as geometric isomers. This permitted an unusual application of molecular substituent parameters available from the literature in a linear relationship to the free energy term. Methods for predicting optimal chromatographic conditions or for identifying unknown aryl, alkyl, or alicyclic groups were demonstrated. SCX column performance varied for individual organotin species, as did the HPLC/GFAA system detection limits. In all cases the limits were in the range of 5 to 30 ng (as tin). (Baker-FRC)
W82-04037

CONCENTRATION AND ISOLATION OF ORGANIC ACIDS ON GRAPHITIZED CARBON BLACK,
Rome Univ. (Italy). Ist. di Chimica Analitica.
A. Lagana, G. Goretti, B. M. Petronio, and M. Rotatori.
Journal of Chromatography, Vol 219, No 2, p 263-271, 1981. 7 Fig, 3 Tab, 23 Ref.

Descriptors: *Water analysis, *Chromatography, Measuring instruments, Carbon, *Organic acids, Phenols, River, *Pollutant identification, Industrial wastes.

A study was made of the application of graphitized carbon black to the extraction of traces of organic acids. The method was tested for recovery of organic acid from human urine and phenols from river water. In the river water studies, one liter of a sample at pH 4 was passed through the column packed with 1000 mg graphitized carbon black (GCB) at a flow rate of 240 ml/hr. The adsorbed substances were recovered with 75 ml of benzene-methanol (3:1). The collection efficiency increased with decreasing flow rates in the range of 800 to 240 mg/hr. When the flow rate was lower than 240 ml/hr, the variation in the collection efficiency was negligible. For the analysis of human urine and river water the amount of GCB and the volume of eluent were deduced respectively from the breakthrough values and from data showing the recovery of model organic compounds from 1000 mg GCB using different eluents. The study clearly showed that the recovery of organic acids by means of columns of GCB adsorbent cannot be carried out without considering the nature of the substances to be recovered and their molecular structure. Since the organic acids differ considerably in solubility and other values, the amount of carbon, the volume of the sample, and the volume and composition of the eluent must be determined for each application. (Baker-FRC)
W82-04038

THE BASF TOXIMETER - A HELPFUL INSTRUMENT TO CONTROL AND MONITOR BIOLOGICAL WASTE WATER TREATMENT PLANTS,
BASF A. G., Ludwigshafen am Rheim (Germany, F.R.).
U. Pagga, and W. Gunthner.
Water Science and Technology, Vol 13, No 9, p 233-238, 1981. 2 Fig, 5 Ref.

Descriptors: *Wastewater facilities, *Monitoring, Water quality, Measuring instruments, *Toxins, Toximeter, *Activated sludge process, Sludge, Wastewater treatment.

A continuously and automatically functioning device, the Toximeter, was developed to act as a safeguard against poisoning of the activated sludge of the BASF wastewater treatment plant. The Toximeter is designed to monitor the toxic properties of the wastewater. Moreover, the Toximeter is useful to test the toxic behavior and the biodegradability of wastewater samples and substances and to check different situations and conditions which may influence the biological treatment process. The Toximeter measures semicontinuously the respiration activity of the microorganisms and sounds an alarm if the respiration decreases significantly. The total Toximeter system as presented is rather complicated and expensive. It is well suited for research purposes, but for practical monitoring it supplies too much information and requires too much servicing. (Baker-FRC)
W82-04050

ISFETS-NEW TOOLS FOR WATER QUALITY MONITORING,
Electric and Musical Industries Ltd., Hayes (England). Central Research Labs.
P. N. Kember.
Water Science and Technology, Vol 13, No 9, p 255-261, 1981. 7 Fig, 9 Ref.

Descriptors: *Water quality, *Measuring instruments, *Monitoring, Ions, Phosphates, Nitrites, Carbonates, Review, *Evaluation, Comparision studies.

A review of various devices and their suitability for water quality monitoring is presented. The devices include ion selective field effect transistors (ISFETs), which are a hybrid of ion selective electrodes (ISEs) and MOSFETs. These hybrids have many advantages over the ISE, especially their in situ impedance transformation. Small physical size and the possibilities of multi-ion sensors and 'on-chip' signal processing are other potential benefits. The response time of ISFETs is not very different from that of ISE's. The MOSFET is very temperature sensitive, and thus ISFETs have similar temperature dependent characteristics. For water quality monitoring purposes the most useful devices would probably be pH ISFETs for general monitoring of the chemical state of the river, bicarbonate to monitor available carbon dioxide, and nitrite and phosphate to monitor fertilizer and sewage discharges as well as the effects of deoxygenation. Finally, monitoring heavy metal ions which have a detrimental effect on most living organisms would be of great interest. One great benefit to be derived from ISFETs is the formation of multi-ion sensors, which is relatively easy to do using semiconductor processing techniques. This coupled with their improved signal to noise ratios due to the in situ impedance transformation and their low unit cost should make ISFETs a very useful device for future use in water quality monitoring. (Baker-FRC)
W82-04059

THEORETICAL CONSIDERATIONS FOR CONTROL AND MONITORING OF WASTEWATER TREATMENT SYSTEMS,
University of Strathclyde, Glasgow (Scotland). Dept. of Applied Physics.
For primary bibliographic entry see Field 5D.
W82-04060

TOXIC SUBSTANCES MONITORING PROGRAM - 1980,
California State Water Resources Control Board, Sacramento.
K. McCleneghan, M. Meinz, D. Crane, and W. Seto.
Water Quality Monitoring Report No. 81-8TS. October, 1981. 56 p. 15 Fig, 11 Tab, 37 Ref, 6 Append.

Descriptors: *Toxicity, *Heavy metals, *Water sampling, *Stream biota, *Fish toxins, Fish, Stream profiles, Hydrocarbons, Tolerance, Fish diets, Data collections, Cadmium, Mercury, DDT, Polychlorinated biphenyls, Endrin, *California.

Since 1976, the Department of Fish and Game has operated a statewide toxic substances monitoring program of freshwater organisms. In 1980, benthic invertebrates and fish were collected and analyzed under three program phases; Routine, Supplemental, and Action Plan. Samples were taken from 27 of the 28 Primary Network streams and from 58 other locations. The Primary Network streams, which form the core program, were chosen on the basis of their importance to the state. Action Plan samples were collected from designated cluster areas where toxic substances had previously been identified. Samples underwent a complete scan for nine heavy metals and 56 synthetic organic compounds. The U.S. Food and Drug Administration has established tolerance levels for toxic substances in fish for human consumption, and none were exceeded in the 1980 samples. To protect predator species, the National Academy of Sciences has also recommended guidelines for maximum residues of toxicants in fish. Other 1980 results showed the biota of some streams contained concentrations of mercury, toxaphene, DDT and its metabolites, and PCBs which exceeded recommended guidelines for the protection of fish and wildlife. Because of improved analytical instrumentation, many synthetic organic compounds were detected for the first time in 1980. Endrin, hexachlorobenzene, and hexachlorocyclohexane concentrations in some fish exceeded the recommended guidelines for protection of fish. The sources of most of these toxic materials are caused by man. (Atkins-Omniplan)
W82-04077

INTENSIVE SURVEY OF THE SABINE-NECHES CANAL - SEGMENT 0703,
Texas Dept. of Water Resources, Austin.
D. D. Ottmers.
IS-19, June, 1981. 28 p. 2 Fig, 5 Tab, 13 Ref, 1 Append.

Descriptors: *Navigation canals, *Water quality standards, *Effluents, *Conductivity, *Water pollution control, Dissolved oxygen, Biological oxygen demand, Suspended solids, Benthic environment, Nitrogen compounds, Sulfates, Chlorides, Water treatment facilities, Hydrogen ion concentration, Specific conductivity, *Sabine-Neches Canal, Texas.

The Sabine-Neches Canal is the maritime shipping route from the Gulf of Mexico to the mouth of the Neches River in Jefferson County, Texas. The purpose of this study was to: (1) determine qualitative cause and effect relationships of water quality; (2) obtain data to upgrade water quality management plans, set effluent limits, and verify the classifications of segments; (3) set priorities for pollution controls; and (4) determine any further water quality management actions required. Six industrial facilities and two municipal sewage treatment plants, which discharge wastewater to the canal, were sampled. Conductivity values were highest near the southern end of the canal and tended to decrease upstream; chloride and sulfate levels followed this trend. Data from the main canal stations showed that dissolved oxygen levels remained above the segment standard of 4 mg/1. Dissolved oxygen levels generally decreased with depth due to reduced photosynthesis, increased salinity, and benthal oxygen demand. Both sewage treatment plants, and the cities of Port Arthur and Groves discharged poor quality effluents and nutrients. Gulf Oil generated the most wastewater but its quality was good; Great Lake Carbon Company discharged an effluent high in total suspended solids (374 mg/l); and U.S. Steel's effluent had excessive nitrates (325 mg/1). The other facilities discharged effluents of generally good quality water. During this study the Canal was able to assimilate the discharges from the six industrial and two municipal treatment facilities without the development of serious water quality problems. (Atkins-Omniplan)
W82-04078

INTENSIVE SURVEY OF ARMAND BAYOU,
Texas Dept. of Water Resources, Austin.
S. R. Twidwell.
IS-20, June, 1981. 25 p. 1 Fig, 5 Tab, 1 Append.

Descriptors: *Bayous, *Water treatment facilities, *Effluents, *Wastewater treatment, Water pollution control, Suspended solids, Treated water, Nitrogen compounds, Chlorides, Sulfates, Biological oxygen demand, Dissolved oxygen, Filtration, Tidal basins, Water quality, Surveys, *Armand Bayou, Texas.

This intensive survey of the Armand Bayou in Southeast Texas was accomplished in July 1980 in accordance with the Texas Water Quality Act and was intended to: (1) determine quantitative cause and effect relationships of water quality; (2) obtain data for updating water quality management plans and setting effluent limits; (3) set priorities for establishing or improving pollution controls; and (4) determine any additional water quality management actions required. Much of this bayou and its tributaries are influenced by tidal exchange with Galveston Bay through Clear Lake; it is an area of significant ecological importance. Seven sampling stations each were established on Armand Bayou and Horsepen Bayou, with additional samples taken from Big Island Slough and the Clear Lake City sewage treatment plant (STP). This study shows that the waters support large populations of algae, whose metabolism produce wide temporal variations in dissolved oxygen; however, in its present state the bayou's dissolved oxygen levels appear to be adequately balanced. Only the middle portion of the Armand Bayou approached critically low levels. The treated sewage effluent from the Clear Lake STP was assimilated in Horsepen Bayou with no serious water quality problems, and this condition should continue if the same level of treatment persists. Water quality modeling results indicate that a treatment level of 5 mg/1 BOD5, 12 mg/1 total suspended solids, and 2 mg/1 ammonia nitrogen imposed on treatment facilities within the basin will maintain a minimum of 4 mg/1 of dissolved oxygen in the Horsepen and Armand Bayous. (Atkins-Omniplan)
W82-04079

INTENSIVE SURVEY OF HUNTING BAYOU,
Texas Dept. of Water Resources, Austin.
D. Petrick.
IS-21, June, 1981. 36 p. 1 Fig, 6 Tab, 13 Ref, 1 Append.

Descriptors: *Bayous, *Water treatment facilities, *Effluents, *Wastewater treatment, Water pollution control, Suspended solids, Treated water, Nitrogen compounds, Chlorides, Sulfates, Biological oxygen demand, Dissolved oxygen, Filtration, Nutrients, Inland waterways, Water quality standards, *Hunting Bayou.

Hunting Bayou in Harris County, Texas was surveyed in October 1979 to: (1) determine quantitative cause and effect relationships of water quality; (2) obtain data to update water quality management plans, and set effluent limits; (3) set priorities for establishing or improving pollution controls; and (4) determine any additional water quality management actions required. A reaeration study was also done in November 1979. Samples were taken from stations in the mainstream of the bayou, from two sewage treatment plants, and from two industries. Dissolved oxygen (DO) levels fluctuated some but were generally depressed at all stations throughout the sampling period. In the early morning, DO levels were less than 2.0 mg/1 at 4 of the 6 stations. Later in the day, DO levels increased to above 5.0 mg/1 at all but one station, indicating oxygen production due to algal photosysthesis. Temperature, pH, and conductivity levels were relatively stable. BOD5 levels were relatively high, ranging from 3.5 to 9.0 mg/1. Ammonia nitrogen and total phosphorus levels were high throughout the bayou. The source(s) of the high nutrient and BOD5 levels are unknown. The high nitrogen and phosphorus levels steadily increased downstream, increasing slightly downstream from each plant. The depressed dissolved oxygen levels indicate that Hunting Bayou is marginally able to assimilate the present wasteloads entering the system without developing serious water quality problems. The data collected during the survey will be utilized by the Texas Department of Water Resources, through mathematical modeling processes, to evaluate specific wasteloads to Hunting Bayou. (Atkins-Omniplan)
W82-04080

AN EARLY WARNING ORGANICS DETECTION SYSTEM FOR THE OHIO RIVER,
Ohio River Valley Water Sanitation Commission, Cincinnati.
G. E. Moore, R. Boes, and L. Weaver.
Journal of the American Water Works Association, Vol 72, No 1, p 21-26, January, 1980. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Chlorinated hydrocarbons, *Organic compounds, Pollutant identification, *Chemical spills, *Ohio River, Path of pollutants, Industrial wastes, Chemical wastes, Hazardous materials, Ohio River Valley Water Sanitation Commission, *Warning systems, Travel time.

An early warning system was developed to detect organic chemical spills in the Ohio River. This was prompted by the February 1977 carbon tetrachloride spill which showed that no agency was equipped to handle unreported incidents of this type. An eight-state compact, the Ohio River Valley Water Sanitation Commission, was organized to fill this void. During the first year of operation seven stations at utilities and industrial facilities performed gas chromatographic analyses

for purgeable halocarbons, identified unreported spills and discharges, computed travel times to downstream water intakes, and alerted appropriate utilities and agencies. The operation of the system was illustrated during May 1978, when chloroform and carbon tetrachloride were found in excess of 50 micrograms per liter at midweek for three consecutive weeks in the Kanawha River. It is believed that the existence of the early warning system has a significant effect on industries discharging chemicals into the river. None of the levels of purgeable organics have exceeded 100 micrograms per liter since the system has been operational. (Cassar-FRC)
W82-04091

MODIFICATIONS OF THE TENTATIVE STANDARD METHOD FOR IMPROVED VIRUS RECOVERY EFFICIENCY,
North Carolina Univ. at Chapel Hill. School of Public Health.
M. D. Sobsey, J. S. Glass, R. R. Jacobs, and W. A. Rutala.
Journal of the American Water Works Association, Vol 72, No 6, p 350-355, June, 1980. 14 Tab, 17 Ref.

Descriptors: *Viruses, *Assay, Enteroviruses, *Pollutant identification, *Water treatment, Filters, Water analysis, Drinking water, Adsorption, Organic flocculation process, Microbiological studies.

Virus recoveries from water samples were improved by modifications in the tentative standard method. Addition of polyvalent cations (MgC12 or A1C13) overcame interferences of tap water constituents. A 0.45 micron fiberglass-epoxy filter was better than the recommended filters. The recommended glycine-NaOH eluting solution as pH 11.5 was not as satisfactory as the same medium at less alkaline pH. Beef extract at pH 9.5-10.5 and concentrations of 0.2-2.4% eluted viruses on the order of 40%. The organic flocculation process was relatively efficient and independent of beef extract concentration or flocculation time for some viruses. Modifications suggested in this study are not final, but indicate possible directions for future investigations. (Cassar-FRC)
W82-04095

EVALUATION OF THE TENTATIVE STANDARD METHOD FOR ENTERIC VIRUS CONCENTRATION FROM LARGE VOLUMES OF TAP WATER,
North Carolina Univ. at Chapel Hill. School of Public Health.
M. D. Sobsey, J. S. Glass, R. J. Carrick, R. R. Jacobs, and W. A. Rutala.
Journal of the American Water Works Association, Vol 72, No 5, p 292-299, May, 1980. 1 Fig, 11 Tab, 30 Ref.

Descriptors: *Viruses, *Assay, Enteroviruses, *Pollutant identification, Water analysis, *Drinking water, Adsorption, Activated carbon, Microbiological studies, Filters.

The tentative standard method for concentrating enteric viruses for water analysis performed poorly during a two year evaluation. Enterovirus recovery (poliovirus type 1, coxsackie viruses A-9 and B-3, echovirus type 7, and bovine enterovirus type 1) ranged from 0.7 to 32%; minute virus of mice 5; and natural enterovirus mixtures from raw sewage, 3.9%. The representative reoviruses and adenoviruses were not recovered at all. There was no statistical difference among recoveries on the four filters used: mixed cellulose ester, fiberglass-epoxy tube, fiberglass-asbestos-epoxy, and fiberglass yarn. Tap water constituents interfered with virus adsorption on filter surfaces. Removal of organic materials with granular activated carbon improved virus adsorption and recovery. Virus adsorption efficiency was directly dependent on the volume of tap water. The recommended eluent, 0.05 M glycine-NaOH at pH 11.5, inactivated 90% of viruses in 1 to 20 min depending on virus type. (Cassar-FRC)
W82-04096

BACTERIAL DYNAMICS IN A WATER SUPPLY RESERVOIR: A CASE STUDY,
Municipal Environmental Research Lab., Cincinnati, OH.
E. E. Geldreich, H. D. Nash, D. F. Spino, and D. J. Reasoner.
Journal of the American Water Works Association, Vol 72, No 1, p 31-40, January, 1980. 8 Fig, 6 Tab, 76 Ref.

Descriptors: *Bacterial analysis, *Water quality, *Fate of pollutants, *Pollutant identification, *Reservoirs, Microbiological studies, Bottom sediments, Sediments, Salmonella, Coliforms, Stratification, Thermal stratification, Storm water, *Cruises Creek Reservoir, Kentucky, Algicides.

A three-dimensional sampling protocol for bacteria in large water supply impoundments is suggested to monitor effects on water quality from environmental changes such as stormwater runoff, inflow of poor quality water from farm wastes, seasonal changes in temperature and stratification, thermal pollution, reduced feeder stream inflow, and microbiological activity in the bottom sediments. Water and sdiments from four sites in Cruises Creek, Walton, Kentucky, were sampled during different seasons and at varying depths to 30 ft. Fecal coliforms ranged from an average of 61 per 100 ml during dry periods to 650 per 100 ml following stormwater runoff. Average total coliform density was 230 per 100 ml in dry periods and 3100 per 100 ml after stormwater runoff. These were much lower than bacterial counts in the feeder stream. The development of the thermocline in August-September caused bacterial densities in the bottom waters to increase to 4000-8400 standard plate count (SPC) per 100 ml and in the surface waters to 11,000-21,000 SPC per 100 ml. Drawing off bottom water in October accelerated destratification; this was reflected in increased bacterial counts followed by decreased bacterial counts at all water levels. Copper sulfate used to control algal blooms produced noticeable decreases in bacterial counts at the surface and mid-depth levels. Survival of three bacteria at different depths was investigated over a 2 year period. All persisted longer at the 6.1 m depth than at the 0.9 m depth. A fecal streptococcus strain was undetectable within 5 days at 6.1 m depth and within 21 days at 0.9 m depth. Salmonella bern and E. coli persisted longer. (Cassar-FRC)
W82-04108

A SURVEY OF QUALITY CONTROL PRACTICES IN WATER BACTERIOLOGY LABORATORIES,
American Water Works Association, New York.
Journal of the American Water Works Association, Vol 72, No 1, p 10-20, January, 1980. 20 Ref.

Descriptors: *Quality control, *Bacterial analysis, *Laboratories, *Laboratory equipment, Pollutant identification, Microbiological studies, Water analysis, Sampling, Culture media, Membrane filters, Thermometers, Incubation.

The American Water Works Association Committee on Microbiological Problems analyzed results of 226 questionnaries on quality control received from water analysis laboratories of all types. 8 to 33% of the laboratories were unaware of possible quality control problems. Over 80% checked their distilled water monthly and when cleaning and repairs were done to the system. Less than 50% performed the inhibitory residue test on glassware. Most respondents did not conform to recommended guidelines for storage lengths of bacterial growth media. Results on use of membrane filters were inconclusive. Calibration of thermometers was generally neglected, especially by water utilities. Problems with incubators and water baths were experienced by many respondents. pH meters presented relatively few service problems, as did autoclaves and hot air ovens. Fewer than half the laboratories had mechanical glassware washers. Interlaboratory testing and information exchange was carried on by 81.4% of the laboratories. The survey pointed out that laboratories in smaller communities have more difficulty with service of equipment and sufficient time for quality control. It is suggested that smaller utilities cooperate to establish central or area laboratories. (Cassar-FRC)
W82-04111

THE BEHAVIOR OF ASBESTOS-CEMENT PIPE UNDER VARIOUS WATER QUALITY CONDITIONS: A PROGRESS REPORT,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 8G.
W82-04119

TASTE AS AN INDICATOR FOR DRINKING WATER QUALITY,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
B. C. J. Zoeteman, G. J. Piet, and L. Postma.
Journal of the American Water Works Association, Vol 72, No 9, p 537-540, 1980. 1 Fig, 5 Tab, 26 Ref.

Descriptors: *Water quality, *Taste, *Indicators, *Drinking water, Odors, Chemicals, Potable water, Pollutant identification, *Netherlands.

This paper considers the value and possibilities of using taste assessment as an indicator of drinking water quality. Chemical water constituents that may contribute to water taste are discussed. Chemical indicators for the presence of organic micropollutants are compared with water taste assessment studies for twenty types of drinking water in the Netherlands. Finally recommendations are made concerning the proper use of taste measurement in water quality control. It is suggested that the use of water taste assessment as a long term water quality indicator can occasionally be supplemented by measuring a small number of chemicals. The use of large laboratory panels for water taste assessment is disparaged. Instead, regular inquiries should be conducted among a group of about 100 consumers in the area supplied by the water treatment plant. This feedback can be used to optimize water treatment processes or to show that certain standards cannot be achieved due to unacceptable contamination of the raw water source. It is further suggested that drinking water should always meet a water taste standard which guarantees that only the most odor-sensitive 5% of the population will still be able to detect an objectionable taste in the drinking water. (Baker-FRC)
W82-04141

SISTER CHROMATID EXCHANGE AS AN INDICATOR OF SHORT TERM CHEMICAL STRESS IN AQUATIC SYSTEMS,
Washington Water Research Center, Pullman.
N. V. Vigfusson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-202078, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, July 29, 1981, 13 p, 2 Fig, 45 Ref. A-102-WASH(1), 14-34-0001-0151.

Descriptors: Chemical wastes, Industrial wastes, Bioassay, Genetic toxicology, Mutagenicity testing, *Sister chromatid exchange, *Toxicity, Insecticides, Mutagenic pollutants, Pesticide toxicity, Organophosphorus pesticides, Chlorinated hydrocarbons, *Bioindicators.

The practicality was examined of the use of sister chromatid exchange (SCE) as a means of assaying, in vivo, the presence of mutagenic/carcinogenic substances in aquatic systems. The central mudminnow, Umbra limi, was exposed to varying concentrations of insecticides Endrin, Chlordane (chlorinated hydrocarbons), Guthion, and Diazainon (organophosphates), and the known mutagen Mitromycin C (MMC). Exposure was followed by in vivo determination of SCE frequencies. Endrin, chlordane and Diazinon caused significant increases in SCE over controls while Guthion did not. These results indicate the potential of in vivo exposure and SCE frequency determination as a bioassay for the presence of DNA damaging pollutants in natural waters.
W82-04161

Group 5A—Identification Of Pollutants

SELENIUM CONTENT AND ITS CHEMICAL FORM IN RIVER WATERS OF JAPAN,
Meterological Research Inst., Tokyo (Japan). Geochemical Research Div.
Y. Suzuki, Y. Sugimura, and Y. Miyake.
Japanese Journal of Limnology, Vol 42, No 2, p 89-91, 1981. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Rivers, *Senelium, *Japan, Chemical analysis, Water analysis.

A study was made on the selenium content in Japanese rivers and the chemical form in which it appears. The rivers sampled included the Ishikari, Mogami, Kitakami, Shimano, Kiso, Yodo, Yoshino, Asahi, and chikugo. The content of total selenium ranged from 33 to 94 ng/liter, with a weighted average of 57 ng/liter. The highest value was found in the water of the Chikugo River, and the lowest value in water of the Mogami River. The fraction of selenium contained in suspended matters was below 10% of the total. The average content of total selenium in Japan was much less than that in the United States. There were two different chemical forms, the tetra- and the hexavalent inorganic ions. No organic form was found. The contents of tetra- and hexa-valent inorganic selenium in river water ranged from 19 to 26 ng/liter and from 11 to 62 ng/liter, respectively, with the respective weighted averages being 22 ng/liter and 29 ng/liter. The tetravalent ion content was nearly constant, whereas that of the hexavalent ion showed a wide range of variation. The average percentage of tetra- and hexavalent ions in the total selenium was 40 and 60%, respectively. In the annual discharge of 30 tons per year, only 3% was derived from suspended matter. (Baker-FRC)
W82-04181

DISTRIBUTION OF MUTAGENS IN TAMA AND AYASE RIVER SEDIMENTS,
Tokyo Univ. (Japan). Faculty of Pharmaceutical Sciences.
K. Hirayama, J. Suzuki, and S. Suzuki.
Japanese Journal of Limnology, Vol 42, No 2, p 82-88, 1981. 3 Fig, 5 Tab, 4 Ref.

Descriptors: *Mutagens, *Sediments, Rivers, *Japan, Bottom sediments, Water pollution, Water pollution effects, *Tama River, *Ayase River.

Mutagenic activity was measured upstream and downstream in the river sediments of the Tama and the Ayase, two rivers remarkable for their water pollution in Japan. Some studies were then made on the chemical properties of DNA attacking substances in the river sediments. Rec-assay employing a recombinationless mutant of Bacillus subtilis detected DNA attacking ability in water extracts from sediments of the Tamamidstream and downstream and of the Ayase midstream. Mutagenic activity was noted in water extracts from sediments of both the Tama and the Ayase, from midstream to downstream, as noted by the reversion assay employing the strain TA 98 of Salmonella typhimurium. Mutagenic activity was not noted in the upstream sediments. Since the mutagenic activity at the majority of the sampling stations increased remarkably when the metabolic activation system of the rat liver was allowed to act on the water extract samples, the presence of a precursor could be inferred, which develops mutagenic activity when acted upon by the enzymes of the liver metabolism. The presence of various types of DNA attacking substances ranging from acidic compounds to neutral ones and amphoteric ones was confirmed by pH fractionation of water extracts from river sediments containing mutagens. According to the gel filtration chromatography of the water extracts, it was found that the DNA attacking chemicals are of different types in the Tama and the Ayase Rivers. (Baker-FRC)
W82-04182

STORM-SEWER INPUT OF HEAVY METALS INTO AN URBAN LAKE ENVIRONMENT,
Western Michigan Univ., Kalamazoo. Dept. of Science Education.
G. A. Duba.
PhD Thesis, April, 1981. 135 p, 32 Fig, 27 Tab, 105 Ref. University Microfilms International, Ann Arbor, MI; Order No. GAX81-17698.

Descriptors: *Lakes, *Heavy metals, *Urban runoff, *Water pollution, Trophic level, Water quality, Fish, Lead, Zinc, Copper, Cadmium, Toxicity, Fisk Lake, *Michigan.

The purpose of this study was to measure the concentration of lead, cadmium, zinc and copper in runoff entering an urban lake ecosystem and to measure the distribution of these metals in selected trophic levels of the lake. Fisk Lake was chosen as the study site and is located in East Grand Rapids, Michigan. Samples were collected to stormwater, rainwater and lakewater together with substrate, aquatic macrophytes Peltandra virginica, chironomid larvae, Chironomidae, snails Physa, and eight species of fish, Ictalurus nebulosus, Esox lucius, Lepomis gibbosus, L. macrochirus, Pomoxis nigromaculatus, Micropterus salmoides, Catostomus commersoni, and Perca flavescens. All samples were collected on the basis of being close to, or distant from, a storm sewer contaminated portion of the lake. Samples were prepared and analyzed using atomic absorption spectrophotometry (AA) and particle induced X-ray analysis (PIXE). The results of the study suggested that: (1) the metals did not show highest concentrations at highest trophic levels; (2) lead, zinc and copper were detected in stormwater; (3) Although some substrate was highly contaminated, the other trophic levels need not show similar contamination; (4) the benthic organisms, although shown to contain elevated metal levels, do not seem to be passing these concentrations along the food chain; (5) the two processes of analysis, PIXE and AA, give similar values; and (6) in terms of metal contamination, the fish of Fisk Lake appear to present little toxic danger. (Sinha-OEIS)
W82-04207

5B. Sources Of Pollution

THE DISTRIBUTION OF MERCURY, CADMIUM AND LEAD BETWEEN WATER AND SUSPENDED MATTER IN THE LOIRE ESTUARY AS A FUNCTION OF THE HYDROLOGICAL REGIME,
UER des Sciences Pharmaceutiques, Nantes (France). Lab. de Toxicologie.
For primary bibliographic entry see Field 2L.
W82-03757

REDUCTION OF CHROMIUM(VI) BY BACTERIALLY PRODUCED HYDROGEN SULPHIDE IN A MARINE ENVIRONMENT,
Otago Univ., Dunedin (New Zealand). Dept. of Microbiology.
R. H. Smillie, K. Hunter, and M. Loutit.
Water Research, Vol 15, No 12, p 1351-1354, December, 1981. 1 Fig, 5 Tab, 18 Ref.

Descriptors: *Tannery wastes, *Chemical reaction, *Chromium, Industrial wastes, Effluents, *Hydrogen sulfide, Bacteria, Marine environment.

the possible contribution from bacteria or their products such as hydrogen sulfide to the reduction of the Cr(VI) in tannery effluents was investigated. Sediment samples were collected from sites in Sawyers Bay, Otago Harbour. The effluent discharged from the tannery into a small creek and hence into the harbour varied in volume, chromium concentration and organic matter content. The study indicated that Cr(VI) could be reduced to Cr(III) in the laboratory by hydrogen sulfide of bacterial origin. The amount of hydrogen sulfide produced by the sulfate-reducing bacteria alone was sufficient to ensure that hydrogen sulfide escapes from the sediment into the overlying water. Since Cr forms sulfide that is not stable in aqueous medium, reduction to Cr(III) is likely to be followed by rapid deposition as hydroxides, either directly or by co-precipitation with iron. Shallow coastal areas received effluents high in organic matter, thus providing conditions in which Cr(VI) could be reduced to Cr(III) by bacterial hydrogen sulfide production. These activities of bacteria and the presence of organic matter may explain the differences in results regarding Cr(VI) persistence or disappearance in the marine environment. (Baker-FRC)
W82-03758

A CULTURE MODEL FOR PHYTOPLANKTON SUCCESSION IN THE POTOMAC RIVER NEAR WASHINGTON, D.C. (U.S.A.),
Georgetown Univ., Washington, DC, Dept. of Biology.
P. Sze.
Phycologia, Vol 20, No 3, p 285-291, 1981. 6 Fig, 3 Tab, 12 Ref.

Descriptors: *Phytoplankton, *Cultures, *Succession, *Algae, *Potomac River, District of Columbia, Diatoms, Cyanophyta, Chlorophyta, Nutrients, Algal growth, Rivers, Model studies, Seasonal variation, Streamflow effect.

A method for simulating the community succession in cultures of planktonic algae was developed using samples collected in the Potomac River near Washington, D.C. This permits monitoring the same community over a prolonged period. Cultures started at different seasons of the year showed a similar sequence of increase: centric diatoms, chlorococcalean green algae, pennate diatoms, and filmanentous blue-green algae. Variation in cultures at their start was related to the abundance of cells in the initial sample. For example, winter samples had low concentrations of cells and showed a lag before growth of centric diatoms was observed. Nutrients were maintained at levels high enough to prevent nutrient limitation. Inhibition of diatom growth with germanium dioxide did not result in an earlier development of green or blue-algae as compared to untreated controls. The results suggest that succession in the river results from different growth rates of the algal group as they are carried downriver. When a river is ampled at a fixed location, early stages of the successional pattern are seen during periods of rapid flow, and green and blue-green algae are predominant during lesser flows. The method may be used to test different environmental conditions (temperature and nutrient levels) on phytoplankton composition. (Cassar-FRC)
W82-03765

BIOLOGICAL COLONIZATION OF AN INDUSTRIAL POND: STATUS AFTER TWO DECADES,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 2H.
W82-03772

GEOLOGICAL CONSIDERATIONS IN HAZARDOUS-WASTE DISPOSAL,
Illinois State Geological Survey Div., Champaign.
K. Cartwright, R. H. Gilkeson, and T. M. Johnson.
Journal of Hydrology, Vol 54, No 1-3, p 357-369, December, 1981. 20 Ref.

Descriptors: *Hazardous materials, *Waste disposal, *Leachates, Toxicity, *Landfills, Waste dumps, Regulations, Standards, Groundwater, Groundwater pollution, Geologic formations, Geohydrology.

Total isolation of wastes in humid areas can not possibly be achieved. Some migration of leachate from wastes buried in the ground will always occur. Performance standards must be supplied by regulations which are applicable on a site-by-site basis rather than rigid criteria for site selection and design. Several factors should be taken into consideration when designing performance standards. These factors should include the categories, segregation, degradation and toxicity of the wastes; the hydrogeology of the site, which governs the direction and rate of contaminant transport; the attenuation of contaminants by geochemical interactions with geologic materials; and the rate of release of unattenuated pollutants to the surface or to the groundwater. An adequate monitoring system is a prime consideration. This monitoring system should test the extent to which the operation of the site meets performance standards and should provide sufficient warning if pollution problems are going to appear so that remedial steps can be taken in time. Over the past few years there has been a trend away from numerous, small disposal sites and toward fewer and larger sites. In essence the size of a disposal site should be based on the attenuation capacity of the geologic material, which has

a finite, though generally not well-defined limit. For those wastes which are slowly degradable, engineering sites with leachate-collection systems appear to be only a temporary solution, as the leachate collected will also require final disposal. (Baker-FRC)
W82-03797

EFFECT OF LEACHATE SOLUTIONS FROM FLY AND BOTTOM ASH ON GROUNDWATER QUALITY,
Kansas Univ., Lawrence. Dept. of Geology.
D. A. Kopsick, and E. E. Angino.
Journal of Hydrology, Vol 54, No 1-3, p 341-356, December, 1981. 5 Fig, 2 Tab, 16 Ref.

Descriptors: *Leachates, Groundwater, *Groundwater pollution, Water quality, *Fly ash, Coal, Calcium, Magnesium, Sodium, Iron, Potassium, Manganese, Zinc, Copper, Lead, Chemical analysis, *Power plants, *Waste dumps, Path of pollutants.

This paper discusses the concentrations of selected elements that can be expected to be released under ash disposal conditions at power plants, as simulated by laboratory experiments. Nine different ashes, six fly ashes and three bottom ashes, were evaluated. These samples represent the coal ash from four United States coal-producing provinces and are a cross-section of the more widely used coals in the United States. Four plants used a pulverized type of combustion (two unwashed), and two used a cyclone type of combustion. Three distinct leaching patterns were noted for the samples studied. The most prevalent trend was characterized by a large initial release of elements in the sample and a leveling off of concentrations at later time periods. A constant release pattern was noted for calcium in the Oklahoma bottom ash and fly ash and Wyoming bottom ash and fly ash. The third leaching trend maximum concentration in the leachate was observed. The eastern Kentucky fly ash sample exhibited this trend. The most commonly noted curve for metal release was the initial flush curve, in which the highest concentrations released are in the initial leachate samples. Therefore the input of large amounts of fresh ash will produce a leachate with elevated concentrations of metals, which may overpower the exchange sites of the soils and sediments and allow contamination to occur. Inactive ponds should produce a leachate with low concentration of metals, which would pose little threat to groundwater quality. (Baker-FRC)
W82-03798

NITROGEN DYNAMICS IN THE SURFACE WATERS OF THE NEW JERSEY PINE BARRENS,
Rutgers - The State Univ., New Brunswick, NJ.
For primary bibliographic entry see Field 2A.
W82-03816

AN ANALYSIS OF SELECTED CLASSES OF ORGANIC CONSTITUENTS IN THE THAMES RIVER ESTUARY,
Connecticut Univ., Storrs.
For primary bibliographic entry see Field 2L.
W82-03819

THE EVALUATION OF THE ELUTRIATE TEST AS A MEANS OF PREDICTING THE BEHAVIOR OF SELECTED CHLORINATED HYDROCARBONS IN DREDGED SEDIMENT DURING OPEN-WATER DISPOSAL,
Texas Univ. at Dallas, Richardson.
For primary bibliographic entry see Field 5A.
W82-03824

NUTRIENT CYCLING IN AN AGRICULTURAL WATERSHED: WATERBORNE NUTRIENT INPUT/OUTPUT BUDGETS FOR THE RIPARIAN ZONE,
Georgia Univ. at Athens.
R. R. Lowrance.
PhD Thesis, June 1981. 305 p, 73 Fig, 38 Tab, 133 Ref, 3 Append. University Microfilms International, Ann arbor, MI; Order No GAX81-23075.

Descriptors: *Watersheds, *Agriculture watersheds, *Cycling nutrients, Riparian waters, Nutrients, Path of pollutants, Agricultural runoff, *Little River basin, *Georgia, Nutrient budgets.

Waterborne nutrient inputs and outputs of the riparian zone of an agricultural watershed were measured during 1979. The study was conducted on a 1568 ha subwatershed of the Little River in the upper coastal plain of Georgia. Concentrations and loads of surface and subsurface flow from the watershed were measured. Total discharge and loads in subsurface movement were less than 1% of surface movement. Concentration variations within the watershed indicate that a hogpen located within 50 m of the stream is not detectable downstream from the hogpen. In general, main channel sites downstream had higher concentrations of most nutrients than tributary streams. Waterborne nutrient budgets for the riparian zone indicated that nitrogen, phosphorus, calcium, magnesium, chloride, and sulfate were accumulated in the riparian zone in 1979. Subsurface inputs exceeded rainfall inputs for all elements except phosphorus. Loadings of nitrogen, calcium, magnesium, and sulfate were disproportionately high from fields compared to pastures and upland pines. The 53% of the water which moved from fields carried 85% of the nitrogen entering the riparian zone. In addition to nitrogen retention, the riparian zone converted inorganic nitrogen inputs to organic outputs. Conversion of even a small part of the riparian ecosystem to fields would increase stream loadings of most nutrients studied, except phosphorus. The largest effect would be on nitrate movement. (Sinha-OEIS)
W82-03825

HYDROLOGICAL STUDIES POSSIBLE WITH RADIONUCLIDES OF BOMB-TEST, PRIMORDIAL AND NATURAL ORIGIN TO COMPLEMENT INVESTIGATIONS USING MANUFACTURED RADIOTRACERS,
K. E. White.
Water Pollution Control, Vol 80, No 4, p 498-512, 1981. 7 Fig, 2 Tab, 25 Ref.

Descriptors: *Radioisotopes, *Tracers, *Dating, Radioactive dating, Radioactive tracers, Lead radioisotopes, Carbon radioisotopes, Argon radioisotopes, Potassium radioisotopes, Cesium radioisotopes, Uranium isotopes, Groundwater movement, Groundwater dating, Precipitation, Hydrology, Sedimentology, Mixing, Aquifer characteristics, *Nuclear explosions, *Fallout, Path of pollutants, Tracking techniques.

Passive radionuclide tracer methods are described. Among the radioisotopes produced by thermonuclear weapons tests during the 1950's and 1960's are Cs137, Sr90, and tritium. Natural radionuclides useful in groundwater studies are U237, U234, Radon222, Pb210, K40, and cosmic ray products. Cs137 has been useful in studies of recently deposited sediments. Tritium is helpful in investigating groundwater movement and precipitation. The decay of U238 to U234 has been used in studies of aquifer characteristics and mixing in estuaries. Radon222 can trace where groundwater springs enter surface waters, mixing patterns in impounded waters, and infiltration of groundwater into sewers. The Pb210 method is a widely used technique for dating sediments over a period of several decades. K40, which decays to Ca40 and Ar40, is useful in investigations of mixing, dispersion, and dilution of effluents or springs. Groundwater infiltration rates, efficiency of atmospheric pollution removal by precipitation (C1 isotopes) and dating water (Ar39 and C14) are a few of the fields in which cosmic ray products can be applied as tracers. These passive methods may be used to complement active tracer methods. They involve no tracer costs or addition of radioactive substances to the environment. (Cassar-FRC)
W82-03836

A SIMULATION OF THE ENRICHMENT OF ATMOSPHERIC POLLUTANTS IN SNOW COVER RUNOFF,
Cold Regions Research and Engineering Laboratory, Hanover, NH.
S. C. Colbeck.
Water Resources Research, Vol 17, No 5, p 1383-1388, October, 1981. 5 Fig, 17 Ref.

Descriptors: *Snowmelt, *Water pollution sources, Thaw, Runoff, Simulation, *Air pollution, *Fallout, Snowfall.

The process of impurity movement through snow is described with specific reference to the effects of the distribution of an impurity within the snow, snow depth, and freeze-thaw cycles. Since snow covers in temperate regions are usually deposited in discrete storm sequences separated by rain and/or melt events, the pollutants are usually not distributed uniformly in the snow cover. Through experimentation it was determined that one of the worst scenarios for environmental damage by sudden release of atmospheric pollutants from the snow cover would be a sequence of melt-freeze cycles followed by a slow melt or rain. The melt-freeze cycles could remove the impurities from the upper portions of the snow cover and concentrate them in the lower portions, where they can be quickly removed with the early water runoff. At the lower flow rates, molecular diffusion is relatively important, so the impurities get into the moving water by diffusing away from their discrete sources. The combination of these two conditions could remove the largest quantity of impurity with the minimum quantity of meltwater. This situation could produce the maximum concentration of impurities, although at less than maximum flow rates. This would be damaging to an aquatic system with a rapid turnover and minimal groundwater flow. In other systems the maximum rate of release of the impurities might be most important, or the repeated daily releases of sudden bursts of impurities. Whatever the most damaging sequence for a particular location, it is very likely to occur at least in an occasional year, as the pattern of weather events leading to snowmelt runoff is quite variable. (Baker-FRC)
W82-03838

DESCRIPTION OF SOIL CHEMISTRY DURING TRANSIENT SOLUTE TRANSPORT,
Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
For primary bibliographic entry see Field 2K.
W82-03840

NITROGEN AND CARBON SOLUTION CHEMISTRY OF AN OLD GROWTH CONIFEROUS FOREST WATERSHED BEFORE AND AFTER CUTTING,
Oregon State Univ., Corvallis. Dept. of Forest Science.
P. Sollins, and F. M. McCorison.
Water Resources Research, Vol 17, No 5, p 1409-1418, October, 1981. 6 Fig, 4 Tab, 51 Ref.

Descriptors: *Forest watersheds, *Clear-cutting, *Nitrogen, *Carbon, Dissolved solids, Watersheds, Forest management, Cutting management, Logging, Litter, Forestry, *Water pollution sources, Comparison studies, Baseline studies.

Data are presented on the concentrations of organic nitrogen, nitrate, ammonium, and dissolved organic carbon (DOC) after clearcutting of old growth from a coniferous forest from a small, low-elevation, montane watershed, located in the Oregon Cascade Mountains. The results were compared with similar data gathered before clearcutting, and factors which may influence concentrations of these substances in forested ecosystems are considered. Nitrate nitrogen concentrations before logging averaged 1-30 micro g/liter. Nitrate first appeared in substantial quantities about 7 months after logging began, but only in the 2.0 meter deep cups. Concentrations in throughfall increased after cutting, while those in precipitation remained relatively constant throughout the 5 year study period. Kjeldahl N began to increase on the watershed about 13-14 months after cutting began at all positions except in throughfall. Ammonium concentrations were highly variable except in litter leachate and showed few consistent differences between the cutover watershed and the control. DOC levels were higher on the clearcut than on the control during both years for which data are available at

all positions in the profile except in litter leachate. DOC values averaged consistently lower in the second year after cutting than in the third in all positions in the profile, including throughfall. The study concluded that dissolved organic N must be measured if total N transfers are to be calculated at most sites, that patterns of nitrate appearance can be explained in part on the basis of decreased availability of oxidizable carbon, that patterns of nitrate appearance after devegetation vary greatly with soil depth and slope, and that dissolved N loss after cutting was small compared with nitrogen removed in tree boles. (Baker-FRC)
W82-03843

FATE OF PRIORITY POLLUTANTS IN LARGE MUNICIPAL TREATMENT PLANTS,
Metropolitan Sanitary District of Greater Chicago, IL.
C. Lue-Hing, D. T. Lordi, and N. P. Kelada.
AIChE Symposium Series, Vol 77, No 209, p 144-150, 1981. 11 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Pollutants, Industrial wastes, Organic compounds, Heavy metals, Raw wastewater, Municipal wastewater, Municipal wastes, *Chicago, Chromium, Copper, Zinc, Iron, Nickel, Cadmium, Cyanides, Phenols.

The pretreatment priority pollutant list contains 129 compounds, a number of which are heavy metals, cyanides and phenols which have been regulated by the Metropolitan Sanitary District of Greater Chicago (MSDGC). Metals most commonly found at high concentrations in the raw sewages of the MSDGC treatment plants include chromium, copper, zinc, iron, nickel, and cadmium. The actual removals of these metals by the activated sludge process demonstrate wide variations, with some average removals as high as 98% and some as low as 17% for specific metals. The effluents from all plants show consistently low concentrations of these metals, and for all practical purposes, the concentrations of a particular metal are virtually identical in the various effluents. Metals are found to concentrate in the various sludges generated by the treatment plants. The degrees to which metals are concentrated in the sludge in terms of concentration factors range from 4,000 to 21,000 and vary from plant to plant. The actual levels found in the sludges appear to be related to the influent concentrations of the particular metal. PCN concentrations ranged from 0.63 to 1.32 micrograms/liter, with a subsequent reduction in the effluents to a range of 0.09 to 4.8 micrograms/liter for MSDGC plants. A preliminary screening of the influents, effluents and sludges from four MSDGC plants showed relatively few of the organics occurring in detectable quantities. (Baker-FRC)
W82-03867

DISTRIBUTED METHOD OF SOLVING THE CONVECTIVE-DISPERSION EQUATION: 2. ERROR ANALYSIS AND COMPARISON WITH OTHER METHODS,
Sandia National Labs., Albuquerque, NM.
J. E. Campbell, D. E. Longsine, and M. Reeves.
Advances in Water Resources, Vol 4, No 3, p 109-116, September, 1981. 9 Fig, 5 Tab, 6 Ref.

Descriptors: *Path of pollutants, *Regression analysis, *Mathematical models, *Nuclear wastes, *Solute transport, Fate of pollutants, Mathematical analysis, Mathematical equations, Radioisotopes, Model studies, Risks, Statistical methods, Model testing, Mixing, Groundwater pollution.

In this second part of a two-part report, statistical sampling and regression analysis techniques were used to evaluate the numerical dispersion which accompanies the grid-block mixing technique of the distributed velocity method (DVM). This technique was developed to perform a risk assessment scheme for a nuclear waste repository. Demands for performing the risk assessment include a computational efficiency over a broad range of Peclet numbers, the ability to handle chains of decaying radionuclides with extreme contrasts in both half lives and solution velocities, and the capability of treating solubility- or leach-limited sources. The DVM was applied to the problems of convective-dispersive transport and compared with other such models. The DVM, so far, seems to satisfy the demands of error analysis and risk assessment, and represents an important complement to the existing transport methodology. (Geiger-FRC)
W82-03873

RADON AND RADIUM DISCHARGE TO SURFACE STREAMS,
V. T. Dubinchuk.
Water Resources (English translation), Vol 8, No 1, p 40-52, January/February, 1981. 6 Fig, 16 Ref. Translated from Vodnye Resursy, No 1, p 102-116, January/February, 1981.

Descriptors: *Radium, *Radon, *Streams, Subsurface water, Model studies, Hydrologic models, Groundwater movement, Inflow, *Surface-groundwater relations, Water pollution sources, *Path of pollutants.

Several models describing the entry of radium and radon into surface waters are discussed. These methods are useful for studying the sites and rates of discharge of subsurface waters into streams. The following cases are examined: concentrated entry of radon (in the form of a gas jet or with an ascending concentrated flow of radon-containing subsurface water), entry of radon into a stream at a constant rate per unit length of the stream, and entry of both radon and radium with subsurface waters with constant flow rate per unit length of the stream. The relationships allow estimates of the effect of factors forming local and regional background contents of radon, the character and magnitude of anomalies in the radon content of surface streams due to entry of radon-and radium-containing subsurface waters, the character of discharge of subsurface gas and water to surface streams, and radiogeochemical prospecting. (Cassar-FRC)
W82-03881

DETERMINATION OF RECENT DEPOSITION RATES IN LAKE CONSTANCE WITH RADIOISOTOPIC METHODS,
Heidelberg Univ. (Germany, F. R.). Inst. for Sedimentology.
For primary bibliographic entry see Field 2J.
W82-03883

LABORATORY AND FIELD STUDIES OF THE RELATIVE MOBILITY OF 239, 240PU AND 241AM FROM LAKE SEDIMENTS UNDER OXIC AND ANOXIC CONDITIONS,
Argonne National Lab., IL. Radiological and Environmental Research Div.
J. J. Alberts, and K. A. Orlandini.
Geochimica et Cosmochimica Acta, Vol 45, No 10, p 1931-1939, October, 1981. 8 Tab, 35 Ref.

Descriptors: *Lake sediments, *Chemical composition, *Americium, *Plutonium, Oxides, *Lake Michigan, Actinides, Chemical reactions, Stratification, Aerobic conditions, Anaerobic conditions, *Fate of pollutants, Radioactive wastes.

Studies were made to determine the relative mobility of plutonium-239, 240 and americium-241 from Lake Michigan sediments under aerobic and anaerobic conditions. Some plutonium and americium could be removed from these sediments by Chelex resin under aerobic conditions at a pH near neutrality. Americium appeared to be more easily extracted than plutonium. Both elements were extracted at rates similar to those obtained in studies using a floodplain soil. The extraction of Pu and Am is not correlated with extractable Mn nor Fe. Plutonium did not appear to be associated with organic matter to any significant degree. Extraction under anoxic conditions indicated no significant differences in the extractability of either plutonium or americium relative to extractions under oxic conditions. The study of a natural system which undergoes intensely anaerobic conditions for long periods of the year indicates that plutonium and americium are not resolubilized into the overlying waters during stratification. This finding requires that care be taken in extrapolating laboratory observations to field situations, especially the roles played by hydrous oxides and reducing environments in controlling transuranic element biogeochemistry. (Baker-FRC)
W82-03899

DELIVERY OF SUSPENDED SEDIMENT AND POLLUTANTS FROM NONPOINT SOURCES DURING OVERLAND FLOW,
Marquette Univ., Milwaukee, WI. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W82-03902

GROUNDWATER CONTAMINANTS FROM LAND DISPOSAL OF RESIDUES: A SURVEY IN THE PROVINCE OF ANTWERP, BELGIUM,
Provincial Inst. voor Hygiene, Antwerp (Belgium).
J. Verheyden, and P. Voets.
Water Science and Technology, Vol 13, No 4/5, p TOR 1125-1134, 1981. 1 Fig, 4 Tab, 8 Ref.

Descriptors: *Water pollution prevention, *Leachates, *Landfills, *Antwerp, Belgium, Waste disposal, *Water dumps, Industrial wastes, Toxicity, Fate of pollutants, Heavy metals, Water pollution sources, Land disposal.

Leachates from 13 important landfills in the highly industrialized Antwerp, Belgium, area were analyzed after filtration through a 20 cm deep sand layer. The samples were classified into 5 groups based on geologic similarities and results for 20 water quality parameters. Leachates produced no toxicity to guppies, Daphnia, or mice in 3-week exposures and no mutagenicity using the Ames salmonella assay. It was observed that new landfills contained (in descending order) chloride, Na, sulfate, phosphate, nitrate, Ca, and soluble organics. Aerobic biodegradation produced carbonate and sulfate in combination with Ca and Mg. Anaerobic conditions produced ammonia, sulfide, methane, and assorted organic pollutants. To minimize future impact on drinking water sources, unacceptable dumps above aquifers should be closely monitored by analyzing percolates, black leachates should be well-aerated or otherwise treated before discharge into streams, and clay pits should be used for hazardous wastes and those wastes high in heavy metals. (Cassar-FRC)
W82-03911

THE DISTRIBUTION AND MOVEMENT OF SOLUTES DERIVED FROM AGRICULTURAL LAND IN THE PRINCIPAL AQUIFERS OF THE UNITED KINGDOM, WITH PARTICULAR REFERENCE TO NITRATE,
Water Research Centre, Marlow (England).
C. P. Young.
Water Science and Technology, Vol 13, No 4/5, p TOR 1137-1152, 1981. 7 Fig, 5 Tab, 45 Ref.

Descriptors: *Nitrates, *Agriculture, *Solute transport, Path of pollutants, Nutrients, Chalk aquifer, *United Kingdom, Fertilizers, Water pollution sources, Aquifers, *Groundwater pollution.

An investigation of outcrops of the Upper Cretaceous Chalk Aquifer and the Triassic Sandstone Aquifer in the United Kingdom showed that high concentrations of nitrates and other nutrients were present in interstitial waters of the unsaturated zones underlying arable farmland. Conversely, nutrient levels were low under permanent pastures and woodland. A table lists the relative importance of nitrate sources in England and Wales from 1938 to 1972. Fixation (52% in 1938 and 38% in 1972) and rainfall (12% in 1938 and 7% in 1972) decreased in importance as sources of nitrates. The percentages of animal wastes (about 25%) and human wastes (7-8%) remained fairly constant. Inorganic fertilizers became more important, increasing from 2% in 1938 to 23% in 1972. Mathematical models predicted that 5-15% of infiltration bypasses the fine pore structure of the Chalk via the fissure systems, suggesting some intense infiltration events. This shows that nitrate removal by microbial degradation is not present to a significant degree. Simulations of the nitrate concentra-

tions for the Isle of Thanet, Kent, show that nitrate levels will reach 20 mg per liter by the year 2000 and 30 mg per liter by 2050. (Cassar-FRC)
W82-03912

IMPACT OF MINING ACTIVITIES ON WATER QUALITY IN WESTERN NORTH CAROLINA,
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
A. M. Duda, and D. L. Penrose.
Water Resources Bulletin, Vol 16, No 6, p 1034-1040, December, 1980. 3 Fig, 4 Tab, 16 Ref.

Descriptors: *Mineral industry, *Sediment transport, Water quality, *Mine wastes, Suspended sediment, Invertebrates, Aquatic animals, Macroinvertebrates, *Nonpoint pollution sources, Fish, Erosion control, Water pollution effects, North Carolina, Space Pine Mining District.

Water quality investigations in the 3 county Spruce Pine Mining District, North Carolina, revealed that the open pit mining for mica, kaolin, and feldspar caused serious water quality problems. Nonpoint pollution sources (active and inactive surface mines, haul roads, and tailings piles) were responsible for most of the sediments entering streams. Point source discharges contributed only about 5% of the sediment load. Macroinvertebrates averaged 250 organisms of 40 types upstream of the mining operations and 24 organisms of 15 types downstream. Suspended sediments were 46-47 mg per liter during 3 rainstorms $>$ 1 cm of precipitation, 317-1110 mg per liter downstream of inactive mines, and 16,100-43,900 mg per liter in a tributary draining an active mine haul road. Relocating a lime treatment apparatus for acidic water further upstream improved the aquatic macroinvertebrate population. Some management practices which should be implemented in the mining industry are construction of berms and sedimentation basins, seeding and mulching of active and inactive mine sites, and location of haul roads away from streams. (Cassar-FRC)
W82-03926

CONTAMINANT OCCURRENCE IN AN UNCONFINED SAND AQUIFER AT A MUNICIPAL LANDFILL,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. F. Barker, P. M. Buszka, J. P. Hewetson, J. A. Cherry, and C. I. Mayfield.
In: Fourth Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 28-30, 1981. p 393-411, 1981. 7 Fig, 1 Tab, 3 Ref. Department of Engineering & Applied Science, University of Wisconsin-Extension, Madison, WI.

Descriptors: Contamination, Plumes, Sampling, *Pollutants, *Sand aquifers, *Municipal wastes, Land disposal, *Leachates, Piezometers, Infiltration, Carbon radioisotopes, Organic compounds, *Landfills.

A network of multilevel sampling devices is being used to obtain a three-dimensional delineation of the plume of contamination in a shallow permeable sand aquifer at a municipal landfill. It was found that leachate from the landfill near North Bay, Ontario, which lies on a deposit of bedded glaciofluvial sand devoid of carbonate materials, has contaminated much of the local unconfined sand aquifer. The maximum extent of the plume was initially identified using chloride and electrical conductance. Concentrations of iron, sodium, manganese, zinc, major cations, ammonium, organic nitrogen, inorganic carbon, and organic carbon are considerably above background throughout the plume. None of the toxic metals listed in drinking water standards have migrated from beneath the landfill. In spite of the unsightly occurrences of leachate springs and extensive discharge of iron-rich water, the influence of inorganic compounds from the landfill on the quality surface water in the drainage basin is insignificant. The monitoring devices being used in the investigation are bundle piezometers. Groundwater levels are within suction depth, so that water sampling is conveniently accomplished using hand-operated vacuum pumps. Estimates of the average groundwater velocity obtained using the Darcy equation are between 50 and 200 mg/year. Current research is being directed at identifying organic compounds in the contaminated groundwater, assessing the toxicity of the groundwater in the plume, conducting carbon transformation studies using carbon isotopes, and identifying specific organic compounds along the plume. (Garrison-Omniplan)
W82-03933

PREDICTION OF LEACHATE ACCUMULATION IN SANITARY LANDFILLS,
Wisconsin Univ. Madison. Dept. of Civil and Environmental Engineering.
J. R. Gee.
In: Fourth Annual Madison Conference of Applied Research & Practice on Municipal and Industrial Waste, September 28-30, 1981. p 170-190, 1981. 4 Fig, 11 Tab, 19 Ref. Department of Engineering & Applied Science, University of Wisconsin--Extension, Madison, WI.

Descriptors: *Leachates, *Simulated rainfall, *Land disposal, *Sanitary landfills, Simulation analysis, Infiltration, Percolation, Municipal wastes, Industrial wastes, Groundwater contamination, Rainfall simulators, Artificial precipitation.

Leachate is generated as a result of water or other liquids infiltrating a landfill's soil cover (or co-disposed) and thereby percolating through the solid waste and picking up contaminants. The prediction of leachate generation in municipal, industrial or hazardous waste landfills is essential to the design of adequate landfill liners, cover materials, grading, filling sequence, and leachate collection and treatment facilities to prevent ground and surface water contamination. Two state-of-the-art methods exist to predict leachate generation: the Water Balance Method and the Hydrologic Simulation of Solid Waste Disposal Sites (HSSWDS) Computer Model recently developed by the U.S. Army Corps of Engineers. Both methods were originally developed for other purposes and predict leachate generation indirectly. Laboratory and field tests show that the Water Balance Method and HSSWDS have 94 percent and 107 percent average error, respectively. A rainfall simulator was constructed in the laboratory to determine infiltration/percolation relationships for cover soils at an existing landfill known as GROWS landfill. Standard soil tests were performed at the landfill and in the laboratory, and data obtained from these investigations were correlated by the Statistical Analysis System to develop an equation to predict leachate generation at GROWS landfill. Predicted values from this equation have 39 percent average error of actual leachate production at GROWS. The fact that this equation was developed from only eight rainfall simulator tests and still resulted in only 39 percent error of leachate production indicates that leachate generation is a well-defined function. (Garrison-Omniplan)
W82-03934

IMPROVED ANALYTICAL METHODS FOR THE DESIGN OF LEACHATE COLLECTION SYSTEMS,
Residuals Management Technology, Inc., Madison, WI.
For primary bibliographic entry see Field 5E.
W82-03936

APPLICATION OF COMPUTER MODELING FOR THE INVESTIGATION OF GROUNDWATER CONTAMINATION,
GeoTrans, Inc., Reston, VA.
For primary bibliographic entry see Field 5E.
W82-03939

IMPROVING THE RELIABILITY OF GROUND-WATER MONITORING AT INDUSTRIAL WASTE DISPOSAL FACILITIES,
Engineering-Science, Inc., Atlanta, GA.
For primary bibliographic entry see Field 5A.
W82-03940

A HYDROGEOCHEMICAL STUDY OF CONTAMINANT ATTENUATION AND REMOBILIZATION IN THE BIG SWAMP OVERBURDEN NEAR PICTON, ONTARIO,
Queen's Univ., Kingston (Ontario). Dept. of Geological Sciences.
D. E. J. Creasy, R. J. Patterson, and W. A. Gorman.
National Hydrology Research Institute Paper No 10, Inland Waters Directorate Scientific Series No 119, 1981. 53 p, 26 Fig, 10 Tab, 28 Ref, 5 Append.

Descriptors: *Groundwater pollution, Contamination, Landfill sites, Organic sediments, Water quality, *Leachages, Ions, Trace metals, Attenuation, Analytical techniques, *Waste disposal, Hydrogeology, Heavy metals, Chemical analyses, *Landfills, Geohydrology, Big swamps, *Ontario.

Contamination of ground water has been recognized as a frequent problem at sanitary landfill sites used for the disposal of municipal and industrial wastes. Most of the current hydrogeologic research concerning waste disposal has focused on the migration of contaminants through inorganic sediments. To increase our understanding of the interactions between potential contaminants and organic sediments, a detailed study of both organic-rich and inorganic surficial sediments from a location designated as a potential landfill site was conducted. From the data obtained in this study, the effectiveness of organic sediments for attenuating potential contaminants in landfill leachate could be evaluated relative to fine-grained clastic materials. The attenuation capacity of the organic materials was similar to that found in the inorganic sediments tested. The attenuation experiments were conducted using the same bulk volumes of organic and inorganic sediment; hence on a dry weight basis, the organic sediments are two to three times more effective in attenuating potential contaminants. The relatively high hydraulic conductivity of the organic sediments would favour selective channelling of landfill leachate through these materials, and since the rate of ground water flow would be relatively rapid, the significance of dispersion and dilution would be increased. Clastic sediments with similar hydraulic conductivities would likely have much lower attenuation capacities than organic sediments, even when compared on a volume basis. (WATDOC)
W82-03945

A STUDY OF BIOTIC TRANSPORT OF ASBESTIFORM FIBERS IN LAKE SUPERIOR,
Michigan Technological Univ., Houghton. Dept. of Biological Sciences.
S. H. Bowen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-198029, Price codes: A02 in paper copy, A01 in microfiche. Competition Report, November, 1981. 11 p. OWRT-A-118-MICH(1).

Descriptors: *Asbestos, *Asbestiform, Lakes, Trout, Herring, Bioaccumulation, *Fish, Lake Superior, Huron Bay, Path of pollutants, Pollutant identification, Water pollution effects.

Flesh (muscle) samples were prepared from nine specimens; three lake herring (Coregonus artedii), three chubs (Coregonus hoyi), and three lake trout (Salvelinus namaycush). Difficulties were encountered in preparation of three of these samples that made it necessary to preclude them from the final analysis. For the remaining samples, twenty fields were examined and fibers counted. In none of the samples did fiber counts exceed blank levels attributable to low level contamination of materials used in analysis. Consequently, the level of contamination in the flesh of these fishes is at or below the level of detection (2 fibers/mg). Lake trout from Lake Superior were collected from heavily contaminated Minnesota waters and one from uncontaminated Michigan waters in Huron Bay. Although the Minnesota specimens had accumulated asbestiform in the kidneys and, to a much lesser extent in the liver, none of these fish had more than trace levels (3 fibers/mg) of fibers in the flesh. These results show that these commercially important fishes do not concentrate asbestiform fibers in their edible flesh relative to lake water. In fact, on

a volume of fish/volume of water basis, the trout from contaminated Minnesota waters contained about 100 times fewer fibers than the water in which they were living. Consequently, these data indicate that the flesh of commercially important Lake Superior fishes examined contains a very low level of asbestiform fiber contamination and does not represent a significant source of asbestiform fiber exposure to humans who consume it.
W82-03950

MODELING THE TRANSPORT OF HEAT, WATER, AND SOLUTE IN UNSATURATED SOIL AND EARTH MATERIALS,
Illinois State Geological Survey, Urbana.
A. Elzeftawy.
In: Proceedings of the Hydrologic Transport Modeling Symposium, December 10-11, 1979, New Orleans, Louisiana, ASAE Publication 4-80, p 234-245, American Society of Agricultural Engineers, St. Joseph, Michigan. 9 Fig, 25 Ref. OWRT A-097-ILL(2), 14-34-0001-0115.

Descriptors: *Soil types, *Soil water, *Soil water movement, *Computer models, Pollutant transport, Solute transport, Heat transport, *Path of pollutants.

Pollutants and dissolved matter are transported through soils and earth materials. As this transport or movement of matter follows known physical laws, theoretical concepts can, in principle, be used in making predictions of the responses of the soil-water-heat-solute flow system. If we can make adequate predictions, we may then be in a position to modify or manage the behavior of that system. The interactions between the transport of heat, water, and solutes play an important role in the management of the soil-water regime and land waste-disposal sites. The ultimate objective of the application of transport theory to field situations is intelligent management of these areas for the benefit of humans and their environment. Current research on the problem is in two major areas: (1) simultaneous transport of water and solute under isothermal conditions, and (2) coupled transport of water and heat in soils. Almost no research has been done on studying or modeling the movement of water and solute under the influence of temperature gradient. The purpose of this paper is to review the work being done on the modeling of water-solute and water-heat transport in earth materials in general and unsaturated soils in particular and to comment on the mechanisms for heat and aqueous fluid transfer.
W82-03958

LEAD-210 ANALYSES OF SEDIMENT ACCUMULATION RATES IN FIVE SOUTHERN ILLINOIS SURFACE MINE LAKES,
Illinois Univ. at Urbana-Champaign. Water Resources Center.
For primary bibliographic entry see Field 2J.
W82-03960

A SURVEY OF RADIOACTIVE EFFLUENT RELEASES FROM BYPRODUCT MATERIAL FACILITIES,
Nuclear Regulatory Commission, Washington, DC. Div. of Fuel Cycle and Material Safety.
J. R. Cook.
NUREG-0819, August, 1981. 153 p, 10 Fig, 9 Tab, 4 Append.

Descriptors: *Radioisotopes, *Radioactive wastes, *Water pollution sources, *Effluents, Hospitals, Research facilities, Iodine radioisotopes, Cobalt radioisotopes, Industrial wastewater.

A survey of over 3,000 NRC byproduct material licensees was conducted to collect data on annual effluent releases of radioactivity. A questionnaire was sent to licensees who handle radioactive material in unsealed form, including research, medical, and industrial institutions. Half of the returned questionnaires provided detailed information on quantitities of unsealed material annually received and released to air or water. The three most commonly used nuclides were 60 day half-life iodine-125, 8 day half-life iodine-131, and 66 hour half-life molybdenum-99. Iodine-125 together with iodine-131 greatly exceeded the total usage of any other element. The survey shows that the annual amount of nuclides received by about 30% of the facilities are in less than 10 millicurie quantities. Only about 1% of reporting facilities received annual quantities of nuclides that are in excess of 1,000 curies. These facilities account for more than 98% of the total activity received by all facilities surveyed; the majority of this activity was received as metallic iridium-192 and cobalt-60 and used to manufacture sealed sources. All reported annual releases of liquid waste were within the limits specified by NRC, with most facilities reporting annual releases of only a fraction of a curie. It appears that in general the environmental impacts from research, medical, and industrial institutions and organizations licensed by the NRC to possess and use byproduct materials are minimal and correspond to a small fraction of that from natural background. (Moore-SRC)
W82-03963

TIME-OF-TRAVEL STUDY IN THE SEBASTICOOK RIVER BASIN, MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
G. W. Parker.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $7.00, Microfiche $3.50. Geological Survey Open-File Report 81-545, May, 1981. 49 p, 47 Fig, 2 Tab, 3 Ref.

Descriptors: *Water quality, Streams, *Streamflow, *Tracking techniques, Dye releases, Tracers, Flow rates, *Path of pollutants, Water analysis, Data collections, Sampling, *Maine, *Sebasticook River basin.

Time of travel was determined for four reaches of the Sebasticook River, two on the East Branch Sebasticook River and two on the main stem of the Sebasticook River. Reach A included 7.8 miles of the East Branch Sebasticook River from Dexter to Corinna, Maine. Reach B included 8 miles of the East Branch Sebasticook River from Newport to its mouth, and one mile of the Sebasticook River to Peltoma bridge near Pittsfield, Maine. Reach C included 3.5 miles of the Sebasticook River from Hartland to West Palmyra, Maine. Reach D included 31.4 miles of the Sebasticook River from Pittsfield to Winslow, Maine. Using a 20-percent solution of rhodamine WT, three dye tracer study runs were made in each reach. Water samples were collected at 11 sites in the study area. The samples were then analyzed for dye concentrations. Time-of-travel data for each subreach are depicted in a series of illustrations and summarized in tabular form. Examples are given to illustrate the use of the data presented. (USGS)
W82-03982

HYDROLOGIC CONDITIONS AT THE IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO EMPHASIS: 1974-1978,
Geological Survey, Idaho Falls, ID. Water Resources Div.
J. T. Barraclough, B. D. Lewis, and R. G. Jensen.
Geological Survey Open-File Report 81-526 (WRI), April, 1981. 77 p, 46 Fig, 4 Tab, 35 Ref.

Descriptors: *Water pollution sources, *Chemical wastes, *Radioactive wastes, *Water quality, Radioactive waste disposal, Groundwater, Aquifers, Observation wells, Groundwater recharge, Water level fluctuations, Path of pollutants, Infiltration, Geohydrology, *Idaho, Idaho National Engineering Laboratory, *Snake River Plain.

Aqueous chemical and radioactive wastes have been discharged to shallow ponds and to shallow or deep wells on the Idaho National Engineering Laboratory (INEL) since 1952 and has affected the quality of the ground water in the underlying Snake River Plain aquifer. Ongoing studies conducted from 1974 through 1978 have shown the perpetuation of a perched ground-water zone in the basalt underlying the waste disposal ponds at the INEL's Test Reactor Area and of several waste plumes in the regional aquifer created by deep well disposal at the Idaho Chemical Processing Plant (ICPP). The perched zone contains tritium, chromium-51, cobalt-60, strontium-90, and several nonradioactive chemicals. Tritium has formed the largest waste plume south of the ICPP, and accounts for 95 percent of the total radioacticity disposed of through the ICPP disposal well. Waste plumes with similar configurations and flowpaths contain sodium, chloride, and nitrate. Strontium-90, iodine-129, and cesium-137 are also discharged through the well but they are sorbed from solution as they move through the aquifer or are discharged in very small quantities. Strontium-90 and iodine-129 have formed small waste plumes and cesium-137 is not detectable in ground-water samples. Radionuclide plume size and concentrations therein are controlled by aquifer flow conditions, the quantity discharged, radioactive decay, sorption, dilution by dispersion, and perhaps other chemical reactions. Chemical wastes are subject to the same processes except for radioactive decay. (USGS)
W82-03984

PRELIMINARY WATER-QUALITY ASSESSMENT OF THE UPPER WHITE RIVER NEAR INDIANAPOLIS, MARION COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 6B.
W82-03986

WATER-QUALITY RECONNAISSANCE OF HARDING CREEK, LAWRENCE COUNTY, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-03995

WATER-QUALITY DATA FROM A LANDFILL-LEACHATE TREATMENT AND DISPOSAL SITE, PINELLAS COUNTY, FLORIDA, JANUARY 1979-AUGUST 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
G. L. Barr, and M. Fernandez, Jr.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $10.25, Microfiche $3.50. Geological Survey Open-File Report 81-1064, 1981. 76 p, 3 Fig, 8 Tab, 8 Ref.

Descriptors: *Landfills, *Waste disposal, Water quality, Groundwater, Surface water, *Path of pollutants, *Leachates, Oxidation ponds, Aeration, Biological treatment, Aquifers, Observation wells, Well data, Data collections, Water analysis, Chemical analysis, Metals, Trace elements, Nitrogen, Coliforms, *Florida, *Pinellas County, *Wastewater treatment.

Water-quality data collected between January 1979 and August 1980 at the landfill leachate treatment site in Pinellas County, Fla., are presented. Data include field and laboratory measurements of physical properties, major chemical constituents, nitrogen and phosphorus species, chemical oxygen demand, trace metals, coliform bacteria, taxonomy of macroinvertebrates and phytoplankton, and chlorophyll analyses. Data were collected as part of a study to determine water-quality changes resulting from aeration and ponding of leachate pumped from landfill burial trenches and for use in determining the rate of movement and quality changes as the leachate migrates through the surficial aquifer. Samples were collected from 81 surficial-aquifer water-quality monitoring wells constructed in January 1975, February 1979, and March 1979, and 8 surface-water quality monitoring sites established in January 1975, February 1978, and November 1978. (USGS)
W82-03997

PHOTODEGRADATION OF THE LAMPRICIDE 3-TRIFLUOROMETHYL-4-NITROPHENOL (TFM) 1. PATHWAY OF THE DIRECT PHOTOLYSIS IN SOLUTION,
Canada Center for Inland Waters, Burlington (Ontario).
J. H. Carey, and M. E. Fox.

Journal of Great Lakes Research, Vol 7, No 3, p 234-241, 1981. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Pesticides, *Degradation, Fate of pollutants, *Lampricides, Photolysis, 3-trifluoromethyl-4-nitrophenol, Phenols, *Path of pollutants, *Lake Ontario tributaries, Light penetration.

Solutions of 3-trifluoromethyl-4-nitrophenol (TFM) at concentrations of 0.0000225 M per liter in distilled water and two Lake Ontario tributary stream waters were exposed to natural sunlight in September or ultraviolet radiation. Half life for degradation was about 3 days in stream water. The principal photolysis product was gentisic acid (2,5-dihydroxybenzoic acid). A condensation product of TFM and gentisic acid (molecular weight 371) was major product. Other photoproducts were methyl 2,5-dihydroxybenzoate, trifluoromethyl hydroquinone dimethyl ether, trifluoromethyl quinone, methylated 3-trifluoromethyl-5-nitrohydroquinone, and possibly methylated-3-trifluoromethyl-5-nitrosohydroquinone. The final photolysis products appear to be humic acid-type polymers. (Cassar-FRC)
W82-04032

EVALUATION OF RIVER LOAD ESTIMATION METHODS FOR TOTAL PHOSPHORUS,
Environmental Protection Agency, Grosse Ile, MI.
D. M. Dolan, A. K. Yui, and R. D. Geist.
Journal of Great Lakes Research, Vol 7, No 3, p 207-214, 1981. 5 Fig, 3 Tab, 15 Ref.

Descriptors: *Phosphorus, *Rivers, *Pollution load, Fate of pollutants, *Lake Michigan, *Grand River, Michigan.

Ten methods of estimating pollutant loads from river flow rates and pollutant concentrations in samples were evaluated using randomly generated 25-sample subsets of daily total phosphorus loads. Data obtained from intensive pollutant sampling in the Grand River, flowing into Lake Michigan, were used as a comparison. On the basis of the root mean square error the best method was the unbiased stratified ratio estimator, recommended for use when concentration data are limited and daily river flow records are available. Other methods evaluated were five simple methods based on daily, monthly, quarterly, semiannual, and annual average concentrations. The complex methods generally were more adequate. These were based on concentrations from quarterly, semiannual, annual, and stratified regression on log flow. Accuracy was increased by including more samples from the high flow periods. (Cassar-FRC)
W82-04034

RELATIONSHIPS BETWEEN ODOR AND COMMONLY MEASURED WATER QUALITY CHARACTERISTICS IN SURFACE WATER SUPPLIES,
Illinois State Water Survey Div., Champaign.
S. Lin, and R. L. Evans.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-178104, Price codes: A03 in paper copy, A01 in microfiche. ISWS/RI-100/81, 35 p, 9 Fig, 9 Tab, 12 Ref, 3 Append.

Descriptors: *Water quality, *Water sampling, *Odor control, *Lakes, *Chemical analysis, Water supply, Bottom water, Dissolved oxygen, Correlation coefficeint, Surface water, Lake sediments, Water pollution sources, Odor producing algae, Water quality standards, Nitrates, Sulfates, Manganese, Chlorine, *Illinois.

Three man-made public water supply impoundments in Central Illinois were studied for two years (1976-78) to: (1) measure long-term threshold odor numbers (TONs) for raw and finished waters; (2) determine if a correlation exists between TONs and some water quality constituents; (3) identify elements causing excessive TONs; and (4) develop a procedure to predict occurrences of odor and its magnitude. The Illinois Pollution Control Board recommends a maximum TON of 3 in finished water but that standard was only reached from 6 to 13 percent of the time; the geometric means of the three lakes were 5.0, 5.2, and 5.4. The correlation coefficients between the TONs and 20 common biological, chemical, and physical characteristics of the lakes were generally low except for nitrate-nigrogen, sulfate, manganese, and chlorine demand. High TONs usually occurred from May through October as a result of anoxic conditions in the bottom waters. High TONs in finished waters occurred 3-to-4 weeks after high TON pulses in the deep waters of Lakes Canton and Decatur and appeared immediately in Lake Eureka. High TONs can be associated with season, reservoir, stratification, rainfall, stream flow, spring thaw, odor-producing organisms, decaying vegetation and industrial spills. The use of stepwise multiple regression analyses would suggest that monitoring depletion rates of sulfate and nitrate concentrations at Canton and Decatur and manganese and chlorine at Eureka would be worthwhile to predict likely occurrences of impending high TONs. For long-term control, in-lake treatments to minimize dissolved oxygen depletion of bottom waters should be considered. (Atkins-Omniplan)
W82-04081

AN EARLY WARNING ORGANICS DETECTION SYSTEM FOR THE OHIO RIVER,
Ohio River Valley Water Sanitation Commission, Cincinnati.
For primary bibliographic entry see Field 5A.
W82-04091

BACTERIAL DYNAMICS IN A WATER SUPPLY RESERVOIR: A CASE STUDY,
Municipal Environmental Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W82-04108

WELL WATER QUALITY DETERIORATION IN CENTRAL PIERCE COUNTY, WASHINGTON,
Washington Univ., Seattle. Dept. of Environmental Health.
F. B. DeWalle, R. M. Schaff, and M. B. Hatlen.
Journal of the American Water Works Association, Vol 72, No 9, p 533-536, September, 1980. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Well water, *Water pollution sources, Groundwater, Nitrates, Sodium, Calcium, Water quality, Drinking water, Potable water, Aquifer characteristics, Washington, Aquifers, *Septic tanks, Septic wastewater, *Groundwater pollution, *Tacoma area, Washington.

This study was conducted to determine the presence of groundwater contamination by sewage effluent from septic tank drain fields. Records were evaluated of chemical analyses of 98 wells (386 groundwater samples) obtained over a 30 year period from both sewered and unsewered areas in a populated river basin south of Tacoma, Washington. The water supplies serving the area are secured locally from wells tapping aquifers in outwash sand and gravel deposits that are recharged almost entirely by rainwater percolation within the basin. The study recharged almost entirely by rainwater percolation within the basin. The study revealed significantly higher groundwater contamination in areas served by septic tanks and drainfields than in sewered areas. The values of nitrate, chloride, and calcium in the former increased significantly over time. High nitrate concentrations were present primarily in shallow wells of up to 100 meters deep in unsewered areas. A sodium-calcium exchange mechanism would explain the significant calcium increases in unsewered groundwater wells as well as the negative correlation which was noted between calcium and sodium. (Baker-FRC)
W82-04133

ALGAE AS SOURCES OF TRIHALOMETHANE PRECURSORS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
R. C. Hoehn, D. B. Barnes, B. C. Thompson, C. W. Randall, and T. J. Grizzard.
Journal of the American Water Works Association, Vol 72, No 6, p 344-350, June, 1980. 9 Fig, 6 Tab, 14 Ref.

Descriptors: *Algal, *Chlorinated hydrocarbons, *Organic carbon, Phytoplankton, Chlorophylla, *Trihalomethanes, Chlorination, Organic matter, Chlorophyta, Cyanophyta, Water supply, Water treatment, Fate of pollutants, Chemical reactions, Chloroform, Water pollution sources, Reservoirs, Occoquan Reservior, Virginia.

A laboratory study of algal-produced trihalomethane precursors confirmed observations that trihalomethane concentrations in finished water corresponded with chlorophyll a concentrations measured in the Occoquan Reservoir, Annandale, Virginia, during June-November, 1975. Cultures of both green algae (Chlorella pyrenoidosa and Scenedesmus quadricauda) and blue-green algae (Oscillatoria tenuis and Anabaena flos-aquae) yielded extracellular products which on chlorination formed as much coloform as humic and fulvic acids, common trihalomethane precursors. Algal extracellular products produced 0.04-5.0% chloroform carbon from available total organic carbon; algal biomass produced 0.2-4.0%. Greater quantities of chloroform were found during the late exponential phase of algal growth than at other stages in the life cycle. Data on trihalomethane-algal relationships in 1976 and 1977, both years of severe drought, did not follow the trends observed in 1975, a normal hydrologic year. In the dry years chlorophyll a concentrations were quite high and finished water trihalomethanes low. (Cassar-FRC)
W82-04149

EFFICIENTLY REDUCING NONPOINT PHOSPHORUS LOADS TO LAKES AND RESERVOIRS,
Northeastern Forest Experiment Station, Broomall, PA.
C. W. Ogg, R. Heimlich, and H. Pionke.
Water Resources Bulletin, Vol 16, No 6, p 968-970, December, 1980. 1 Fig, 19 Ref.

Descriptors: *Phosphorus, *Nonpoint pollution sources, *Soil conservation, Eutrophication, Model studies, Pennsylvania, Agriculture, Water quality, Lakes, *Reservoirs, Sediment, Water pollution control, Benefits, Erosion control, Runoff, Conservation, Phosphorus removal.

The impace of conservation programs on eutrophication of reservoirs in rural watersheds is predicted using a linear programming model. It establishes relationships between sediment losses, runoff, and phosphorus losses. It simulates reductions in adsorbed P via reductions in runoff and sediment concentrations resulting from conservation measures. P partitioning between dissolved and adsorbed sites in soil and stream sediment are determined by laboratory analysis. The model was applied to four counties in southeastern Pennsylvania. The least costly conservation measures (including terracing, contouring, strip cropping, minimum tillage, no-till, rotations, and combinations of all) were determined for each local soil situation. (Cassar-FRC)
W82-04154

SPNM, A MODEL FOR PREDICTING SEDIMENT, PHOSPHORUS, AND NITROGEN YIELDS FROM AGRICULTURAL BASINS,
Science and Education Administration, Temple, TX. Grassland, Soil, and Water, Soil, and Water Research Lab.
For primary bibliographic entry see Field 6A.
W82-04157

DISTRIBUTION AND ORIGIN OF N-ALKANOIC ACIDS, N-ALKANOLS AND N-ALKANES IN ENVIRONMENTAL SAMPLES (IN JAPANESE),
Tokyo Metropolitan Univ. (Japan). Faculty of Science.
Y. Shigaraki, and R. Ishiwatari.
Japanese Journal of Limnology, Vol 42, No 2, p 72-81, 1981. 3 Fig, 3 Tab, 36 Ref. English Summary.

Descriptors: *Organic compounds, *Environment, *Lakes, Rivers, Channels, Soils, Sediments, *Marine environment, *Path of pollutants, Tokyo Bay, Gulf of Mexico, Comparison studies.

Thirteen samples of sediments, soils and activated sludges from Lake Haruma, Tama River, Houston Ship channel, Tokyo Bay, Galveston Bay, and Gulf of Mexico were analyzed for n-alkanoic acids, n-alkanols, and n-alkanes. The distribution patterns of the compounds were compared with those for the presumed source organisms, as it appears in the literature, were divided into three types in terms of their distribution pattern. The study showed that the compounds in the lake and marine sediments and soils are mostly of terrerestrial, higher plant, origin, while the compounds in the Tama River sediments are considered to originate from algae and/or bacteria. The compounds in the sample from the Houston Ship Channel are strongly influenced by petroleum pollution (Baker-FRC)
W82-04171

NITROGEN AND PHOSPHORUS CONTENT OF FLOW FROM DRAINS FERTILIZED WITH COW MANURE SLURRY,
Macdonald Coll, Montreal (Quebec).
M. M. Iqbal, and B. P. Warkentin.
Plant and Soil, Vol 63, No 3, p 517-521, 1981. 3 Tab, 12 Ref.

Descriptors: *Flow pattern, *Groundwater pollution, Water pollution, *Manure, *Nitrates, Leaching, *Phosphorus, Drainage effects.

The aim of this study was to determine nitrogen and phosphorus losses in the drainage water from manured soils. Two applications of cow manure slurry were annually made at different rates. The application rates were 260, 390 and 620 kg N/ha. The drain flow was found to be directly related to the rainfall and was greatly influenced by soil texture. Nitrogen losses were greater in 1972, at 7.8 to 19.1 kg N/ha, than in 1971, when they were 0.4 to 7.8 kg N/ha due to more summer rainfall. Nitrogen and phosphorus losses were larger from the sandy plots than from the clayey plots. The manure application rates had no apparent effect on nitrogen losses in the drain water. (Baker-FRC)
W82-04183

TRANSPORT OF POLYCYCLIC AROMATIC HYDROCARBONS THROUGH A PARTLY URBANIZED RIVER BASIN,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
R. Herrmann.
Water, Air, and Soil Pollution, Vol 16, No 4, p 445-467, 1981. 17 Fig, 4 Tab, 29 Ref.

Descriptors: *Hydrocarbons, *Water pollution sources, Runoff, Rainfall, Water pollution, Flushing, Rivers, Urbanization, *Urban runoff, Urban watersheds, Path of pollutants.

The relationship between polycyclic aromatic hydrocarbon (PAH) load, PAH concentration and runoff was investigated in an urban environment in an attempt to explain the processes involved in the contamination of rainwater by PAH, as it travels from its point of contact with the surfaces through major drains into the receiving river. The area studied was the river basin of the Sendelbach, which encompasses the southern part of the city of Bayreuth, Upper Frankonia. The outfall to the river is by combined sewer storm-water overflow and small catch basins into the receiving stream. Analysis of rainfall and runoff events showed that because of the high permeability of the soils and the lack of steep slopes there is insignificant surface runoff from the open area of the river basin contributing to the urban runoff. Due to the low retention in the sewer system and catch basins a quick outflow of urban runoff into the receiving Sendelbach existed. The PAH pollutant loads resulting from storm runoff were associated with high concentrations of suspended sediments. As all PAH show similar regional patterns of concentration in snow with high concentrations in densely populated urban areas with heavy traffic, it can be concluded that overland flow from urbanized areas dominates the PAH washoff. The contribution of rain-borne PAH to the PAH in runoff was comparatively low. Nearly all PAH pollutographs showed strong first flush phenomena. (Baker-FRC)
W82-04191

STORM AND COMBINED SEWERS: PART OF THE TREATMENT PROCESS,
Municipal Environmental Research Lab., Edison, NJ.
R. Field.
Water/Engineering and Management, Vol 129, No 1, p 34-36, 39, January, 1982. 5 Fig, 1 Tab.

Descriptors: *Sewer systems, *Wastewater facilities, Storm sewers, Storm-overflow sewers, *Combined sewers, Separated sewers, Economic aspects, Maintenance, Water pollution sources, Flushing.

In view of increasing costs, the best answer to abatement of the combined sewer overflow (CSO) pollution problem is seen to revolve around the management of dual purpose collection systems for both drainage and pollution control. A project was undertaken to study new sewer designs based upon maintaining adequate low flow solids carrying velocity to allviate sewer sedimentation and the resultant first flush pollution and premature bypassing during storms. The following types of system designs were compared: separate storm and sanitary, conventional combined, and advanced combined with varying amounts of in-pipe and/or satellite storage and controlled flow routing. The new method is basically the old combined sewer incorporating inline storage for wet-weather flow. The study proved that providing additional storage in a new combined sewer system should result in the least cost system for pollution control. Sewer flushing was viewed as an effective means for substantially reducing solids deposited during dry weather in small diameter combined sewer laterals, alleviating wet-weather CSO pollution and reducing downstream treatment requirements. Polymer slurry injection into sewage has resulted in significant hydraulic friction reductions. Inflow reduction techniques maximize the collection and treatment capabilities and prevent downstream overflow pollution by limiting extraneous sources. Surface ponding, flow routing and in-pipe storage are also discussed. (Baker-FRC)
W82-04195

NUMERICAL MANAGEMENT MODELS OF GROUNDWATER POLLUTION,
Stanford Univ., CA.
S. M. Gorelick.
PhD Thesis, December, 1980. 158 p, 32 Fig, 10 Tab, 45 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-08935.

Descriptors: *Mathematical models, *Linear programming, *Water pollution sources, Simulation analysis, Water pollution control, Management planning, Groundwater management, Groundwater pollution, Wastewater disposal.

Quantitative descriptions of the functioning of groundwater-solute systems are incorporated into management models. This combined use of simulation and management methods is shown to be valuable in managing aquifers that are used for both waste disposal and water supply. The models employ numerical simulation techniques, linear programming, and linear superposition to inspect problems of hydraulic management as well as groundwater pollution management. A series of hypothetical groundwater pollution problems are used to develop and demonstrate the management methods. Parametric programming is shown to be quite valuable in evaluating waste disposal tradeoffs at various facilities over time. The combined use of linear programming and simulation models are applied to problems of pollutant source identification. Steady state and transient models are developed which address the problems of locating unknown pollutant sources and determining pollutant source magnitudes even though data are sparse, spatially distributed, and in error. (Sinha-OEIS)
W82-04211

THE GEOCHEMICAL CYCLING OF HYDROCARBONS IN LAKE JACKSON, FLORIDA,
Florida State Univ., Tallahassee. Dept. of Oceanography.
C. J. Byrne.
PhD Thesis, December, 1980. 184 p 22 Fig, 29 Tab, 115 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No. GAX81-06262.

Descriptors: *Lakes, *Hydrocarbons, *Water quality, *Storm runoff, Urban runoff, Water pollution sources, Geochemistry, Sediments, Water quality control, *Florida, *Lake Jackson, Automotive hydrocarbons.

Lake Jackson is a freshwater lake in northwestern Florida that is experiencing changes in the quality of water discharge into it from the surrounding watershed. Increasing urban encroachment is resulting in greater concentrations of urban pollutants, especially petroleum hydrocarbons. The principal source of the petroleum hydrocarbons is stormwater runoff from the surrounding urbanized areas of the watershed. Of the 4380 kg of total hydrocarbons transported to the lake in the stormwater runoff during 1978-79, over 90% were of petroleum origin. Another large source of petroleum hydrocarbons was that associated with dustfall of the area. Gas chromatographic analyses of the stormwater runoff and dustfall suggests that the petroleum hydrocarbons present in these samples resemble the types of hydrocarbons present in automotive activities (i.e., gasoline exhaust, used crankcase motor oil). Examination of the sediments in the Lake Jackson Basin reveals that marked increases in petroleum hydrocarbon concentrations occurred after 1963. This agrees with the known urban expansion of the area of the lake. At present the Florida Department of Environmental Regulations and the United States Environmental Protection Agency are constructing a pollution abatement system which is designed to decrease the flow of hydrocarbons and other potentially toxic chemicals from entering the lake via stormwater runoff. (Sinha-OEIS)
W82-04215

THE DISTRIBUTION OF HEAVY METALS AND PETROLEUM RESIDUES IN THE SOIL FROM URBAN SURFACE RUNOFF,
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
M. Owe.
PhD Thesis, January, 1981. 197 p, 56 Fig, 22 Tab, 100 Ref. University Microfilms International, Ann Arbor, MI; Order No. GAX81-18121.

Descriptors: *Urban runoff, *Surface runoff, *Soil properties, *Heavy metals, Oily water, Water pollution, Water pollution sources, New York.

The soil is thought to possess an enormous capacity for immoblizing environmental contaminants, especially those typically contained in urban surface runoff. The profiles of two common area soils, a sandy, porous Arkport and a dense clayey Dunkirk, were reconstructed in 14 cm by 80 cm columns in the laboratory. The design was intended to simulate a collection basin, one fourth the surface area of the test basin. Surface runoff was sampled and collected from a heavy used shopping center parking lot. Treatments simulated actual precipitation-runoff event frequency and volume occurring during the study period. The profiles were subsequently analyzed at predetermined increments for zinc, lead, cadmium, copper and petroleum residues. An overall increase in total cation and petroleum concentration was noticed with an increase in treatment concentration. A positive relationship between contaminant concentration in the soil and treatment level, exchange capacity, final soil pH and percent organic matter was realized. A negative correlation was noticed between contaminant concentration and bulk density. Treatment level and final soil pH experienced a strong negative correlation. Although both soils yielded recovered totals far below the input amounts, consistently lower hydrocarbon totals were recovered from the Arkport. This indicates the possibility of a higher rate of petroleum residue decomposition in the

more porous, better aerated Arkport soil. (Sinha-OEIS)
W82-04216

CORRELATION OF SELECTED WELL WATER QUALITY PARAMETERS WITH SOIL AND AQUIFER HYDROLOGIC PROPERTIES,
Science and Education Administration, Fresno, CA.
H. I. Nightingale, and W. C. Bianchi.
Water Resources Bulletin, Vol 16, No 4, p 702-709, August, 1980. 5 Fig, 8 Tab, 10 Ref.

Descriptors: *Water quality, *Soil properties, *Aquifer characteristics, *Wells, Groundwater pollution, Nitrates, Conductivity, Permeability, Statistical analysis, Salinity, Fresno, Clovis, *California, Pollutant identification, Water pollution sources.

Investigation of well water electrical conductivity and nitrate levels and soil and aquifer permeability in a 932 sq km region near Fresno-Clovis, California, produced the hypothesis that well water quality would be higher in areas with permeable soils and aquifers. Correlation and multiple linear regression analysis showed this was true for well water salinity. However, nitrate levels were negatively correlated with only the estimated equivalent specific yield of the aquifer system. Only a third of the variability in well water specific electrical conductivity and nitrate levels could be attributed to the soil and aquifer characteristics. The remainder of the variability in groundwater salinity and nitrate levels may be related to land use (fertilizers, septic tanks, etc.). Better land use management would probably improve well water quality and reduce its variability. Arithmetic means of well water quality parameters (in mg per liter) were Na, 22.6; K, 3.2; Ca, 32.4; Mg, 18.2; nitrate, 21.2; Cl, 14.6, sulfate, 15.0, bicarbonate, 185.2; and specific electrical conductivity, 415.2 micromhos per cm at 25 C. (Cassar-FRC)
W82-04242

5C. Effects Of Pollution

EFFECT OF A DEEP-WATER OUTFALL FROM A POWER-PLANT RESERVOIR ON WATER QUALITY IN THE LOWER POOL,
V. F. Brekhovskikh.
Hydrotechnical Construction, Vol 15, No 1, p 1-4, January, 1981. 3 Fig, 8 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 1, p 14-16, January, 1981.

Descriptors: *Water quality, Reservoirs, *Powerplants, *Dissolved oxygen, Temperature effects, Oxygen demand, *Reservoir releases, *Self-purification, Downstream, Monitoring, Streams, Waste-assimilative capacity.

The effect of various hydrological, thermal and biochemical factors was assessed on the rate at which water quality was restored in river segments below a dam, where the dissolved-oxygen content is adopted as the quality criterion. A one-dimensional stationary flow model was examined, with the following assumptions: the stream velocity is constant over the cross section and does not change with distance; the rate of atmospheric aeration depends only on the deficiency of dissolved oxygen, and photosynthesis is absent; the process of the biochemical oxidation of organic matter is described by monomolecular reactions at any dissolved oxygen concentration; additional pollution of the river and the absorption of dissolved oxygen by bottom sediments are distributed uniformly over the length of the river; and the heat flux does not change with the time of day. On the basis of the results it was concluded that at stream velocities characteristic of a river in the natural state, an outfall of water with a low dissolved oxygen content apparently will not present a serious risk to the activity of aquatic organisms, since the water will be rapidly saturated with oxygen by atmospheric aeration alone. This aeration is most vigorous in the zone connecting the pools. In the presence of photosynthesis, the level of dissolved oxygen will increase more rapidly. If stream velocity is low, the outfall of deep water with a low dissolved oxygen concentration may have undesirable consequences. (Baker-FRC)
W82-03768

ON THE QUALITY AND SOME ECOLOGICAL EFFECTS OF WASTEWATER EFFLUENTS FROM TWO CHEMICAL INDUSTRIAL PLANTS IN PAKISTAN,
Punjab Univ., Lahore (Pakistan), Dept. of Botany.
K. H. Sheikh, and S. Ahmad.
Environmental Conservation, Vol 8, No 3, p 229-234, Autumn, 1981. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Industrial wastes, *Environmental effects, *Waste disposal, Water quality, Channels, Irrigation, Germination, Outfall, *Ecological effects, *Pakistan.

The quality of wastewater effluents from two chemical industrial plants was determined: Ravi Rayon Limited, which makes acetate rayon and ethanol, and Ittehad Chemicals, makers of caustic soda and bleaching powder. The quality and biota of Dek Nullah channel 'pure' water and 'polluted' water were also determined. Pure and polluted refer to samples taken respectively before and after the effluents from these two industrial plants reach the water body. The analysis showed that the pure water was the best in quality; wastewater of the Riva Rayon plant was of high salinity and low sodium content; wastewater from the Ittehad Chemicals plant was of the poorest quality, being of very high salinity and very high sodium content; and water from the polluted Dek Nullah channel was of relatively bad quality, with high salinity and medium sodium concentrations. Only the water from Ittehad Chemicals had some sediment in it, the qualitiative analysis of which showed the presence of oxalates, sodium, iron, and magnesium. The planktonic biota in the pure water was more diversified than in the polluted water. The polluted water is used by farmers further downstream for irrigation. Rice germination was determined to be much greater when pure rather than polluted water was used for irrigation. Proper management techniques are needed to avoid salinity and sodicity problems from developing in soil areas where the polluted water is used for irrigation. (Baker-FRC)
W82-03773

ACCUMULATION OF POLYCHLORINATED BIPHENYLS IN ATLANTIC TOMCOD (MICROGADUS TOMCOD) COLLECTED FROM THE HUDSON RIVER ESTUARY, NEW YORK,
Texas Instruments Inc., Buchanan, NY.
R. J. Klauda, T. H. Peck, and G. K. Rice.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 6, p 829-835, December, 1981. 1 Tab, 26 Ref.

Descriptors: *Polychlorinated biphenyls, *Estuarine environment, Aroclors, Environment, Estuarine fisheries, Fisheries, Coasts, *Hudson River, Fish, Tomcod, *Fish diseases, Carcinogens.

The results of PCB residue measurements in liver, gonadal and body tissues of adult Atlantic tomcod are presented. PCBs, identified as a mixture of Aroclors 1016 and 1254, were detected in all tissues. Concentrations of PCBs in body tissue ranged from 0.01 to 0.67 micrograms/g. Mean concentrations of total PCBs in gonads and livers were 1.17 micrograms/g and 37.52 micrograms/g. PCB residues in ovarian tissues were generally lower than in testes. A trend was noted toward lower levels of PCBs in the tissues of larger Atlantic tomcod. The study indicated that the tissues of adult Atlantic tomcod collected in the Hudson River estuary contain elevated levels of PCBs, especially in the liver tissue. However, any role of PCBs in the induction of hepatomas is unclear. Further study is requested to determine possible casual relationships between PCBs and hepatocellular carcinoma as observed in the Atlantic tomcod from this estuary. (Baker-FRC)
W82-03777

COMMENT ON 'A RELATION BETWEEN LAKE MORPHOMETRY AND PRIMARY PRODUCTIVITY AND ITS USE IN INTERPRETING WHOLE-LAKE EUTROPHICATION EXPERIMENTS' (E.J. FEE),
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
K. Patalas.
Limnology and Oceanography, Vol 25, No 6, p 1147-1149, November, 1980. 6 Ref.

Descriptors: *Lake morphometry, *Epilimnion, *Productivity, Nutrients, Eutrophication, Phytoplankton, Water pollution effects.

Comments on Fee's (1979) paper include a simplification of an equation to predict production from the ratio of surface area of a lake bottom in contact with the epilimnion to total lake surface area. This agrees with concepts stated by other authors--Seligo as modified by Naumann (1931) in that productivity is related to the proportion of the littoral area; by Ohle (1952), in that productivity of lakes with tropholytic layers of comparable volumes can depend on morphological characteristics of the epilimnion; and by Patalas (1966), in that the larger the active bottom layer or the part of lake bottom under the influence of oxygen containing epilimnion in summer, the greater the productivity. However, Fee's rejection of the inverse relationship between mean depth of lakes and productivity is criticized. (See Abstract No. W80-02462 for subject paper) (Cassar-FRC)
W82-03780

ENVIRONMENT AND PUBLIC HEALTH IN THE CARIBBEAN,
Pan American Health Organization, Washington, DC.
For primary bibliographic entry see Field 6D.
W82-03787

MERCURY CLEAN-UP IN CANADA'S LAKE ST. CLAIR: ONLY A PARTIAL SUCCESS,
University of Western Ontario, London. Dept. of Zoology.
D. M. Ogilvie.
Ambio, Vol 10, No 6, p 350-351, 1981. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Mercury, *Lakes, Fish, *Water pollution sources, *Industrial wastes, *Fishing industry, Environmental effects, *St. Clair River, Canada.

In 1970 fish taken from Lake St. Clair contained mercury levels as high as 7 ppm and the sale and export of these fish stopped. The mercury was traced to Dow chlor-alkali plants which discharged an estimated 100,000 kg of mercury into the St. Clair River between 1950 and 1970. Within a few months' time mercury losses, which had been as high as 31 kg/day, were reduced to less than 0.4 kg/day. By 1973 a new chlor-alkali plant was finished which uses a mercury free process. Mercury concentrations in Lake St. Clair have been monitored yearly. During the 10 years from 1970 to 1980 the mercury levels in specific fish species decreased by 35 to 80.5%. Some dredging was conducted in the lake since 1977, and it is possible that resuspension of mercury-containing sediments may have slowed the fall in mercury levels. Some fish taken in the 1980 samples still contained from two to five times the 0.5 ppm limit established for human food. (Baker-FRC)
W82-03788

AN EPIDEMIOLOGICAL STUDY OF WELL-WATER NITRATES IN A GROUP OF SOUTH WEST AFRICAN/NAMIBIAN INFANTS,
Royal Manchester Children's Hospital (England). Dept. of Clinical Genetics.
M. Super, H. de V. Heese, D. MacKenzie, W. S. Dempster, and J. du Plessis.
Water Research , Vol. 15, No 11, p 1265-1270, November, 1981. 16 Tab, 12 Ref.

Descriptors: *Epidemiology, *Nitrates, Methemoglobinemia, *Water pollution effects, *Infants, *South West Africa, Drinking water, Human pathology, Nitrogen compounds, Vitamins.

A study of 486 infants consuming well water containing nitrates showed strong correlation between nitrate intake and blood methemoglobin levels. 51 of 344 infants consuming < or = 2.93 mg nitrate per hours and 42 of 108 consuming > 2.93 mg per 24 hours had methemoglobin levels > 3.0%. 38 of 293 infants living in low nitrate regions (< or = 20 mg per liter) and 64 of 193 infants living in a high nitrate region (> 20 mg per liter) had methemoglobin levels > 3.0%. The highest methemoglobin level (35%) was found in a child drinking well water with 56 mg per liter nitrate. Babies receiving daily Vitamin C supplements had lower methemoglobin values than those receiving infrequent or no Vitamin C. There was no statistical correlation between methemoglobin levels and the following: age of infant, fits, breath-holding attacks, diarrhea, respiratory infections, prematurity, blood parameters, physical size, gastric pH, stillbirths, and abortions. However, siblings of children living in high nitrate regions had a higher death rate in the first year than those living in low nitrate regions. (Cassar-FRC)
W82-03831

PARAMETER ESTIMATION IN EUTROPHICATION MODELLING,
International Society of Ecological Modelling, Copenhagen (Denmark).
For primary bibliographic entry see Field 2H.
W82-03863

THE IMPACT OF EUTROPHICATION ON WATER TREATMENT AND SUPPLIES IN THE ANGLIAN WATER AUTHORITY,
L. A. Greene, and C. R. Hayes.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 5, p 421-436, September, 1981. 1 Fig, 4 Tab, 22 Ref.

Descriptors: *Water management, *Eutrophication, Water supply, Water demand, *Water treatment, Phosphates, Nitrates, Surface water, Water storage, Reservoirs, *United Kingdom.

A large portion of the water supply in the Anglian Water Authority comes from surface water storage reservoirs. This dependence will increase in the future as the population of the area continues to expand. Algal growth in several reservoirs caused serious recurrent water treatment and water quality problems. This has sometimes necessitated a significant reduction in works outputs, and in rare cases, complete closure of the works. The Authority operates 12 public water supply reservoirs. The major river sources in the area are rich in both nitrates and phosphate due to the agricultural nature of the catchments and the discharge of sewage effluents. Major water treatment problems are found with reservoirs where retention is short - less than one year. Conventional physicochemical water treatment plants are not generally able to produce water supplies to acceptable quality standards during periods of intensive algal development. Adverse eutrophication effects are manifested in distribution system water quality losses. Possible related factors include the development of animals in distribution systems and discoloration from the accumulation of hydrated inorganic oxides and organic matter, bacteriological deteriortation, haloforms, and aluminum. Increasing water supply demands from eutrophic lowland reservoirs entails an increasing potential for raw and treated water quality deterioration. Coordinated monitoring and preventative remedial expenditure decisions are needed, based on consideration of the integrated river/reservoir/treatment works/distribution network systems as a whole. (Baker-FRC)
W82-03866

WATERBORNE DISEASE IN THE UNITED STATES AND CANADA.
Journal of the American Water Works Association, Vol 73, No 10, p 528-529, October, 1981. 15 Ref.

Descriptors: *Public health, *Human diseases, Water pollution, Water treatment, Drinking water, Potable water, Surface water, Disinfection, Epidemiology, Monitoring, *Water pollution effects, *Waterborne disease, United States, Canada.

Several recommendations have been made following examination of data on waterborne disease outbreaks in the United States during 1971-78 and in Canada during 1974-77 as collected by the Center for Disease Control in Atlanta, the Health Effects Research Laboratory of the EPA in Cincinnati, and the Health Protection Branch of the Canadian Health and Welfare Department in Ottawa. The increase in outbreaks is viewed as a result of better reporting being carried on in the United States. Current data should be useful in establishing and maintaining priorities for future surveillance of water supplies. Surveillance in the following particular areas should decrease the incidence of waterborne disease: small systems relying primarily on groundwater, water systems used on a seasonal basis, and system contamination due to cross connections, backsiphonage, uncovered finished water storage facilities, construction, and repair of water mains. Simple disinfection as the only treatment for surface water sources is ineffective in preventing waterborne transmission of giardiasis. While turbidity that interferes with disinfection is health related, forms of turbidity such as iron precipitate or other inorganic matter are not health related. Coliform organism identification is used as an indication of fecal contamination of water supplies and is widely employed for routine surveillance. Waterborne outbreaks of viral etiology have occurred due to contamination of the distribution system, interrupted or inadequate disinfection, or no treatment of contaminated water sources. Most waterborne disease outbreaks are of unidentified etiology. Increased recognition and investigation of outbreaks should reduce these occurrences. (Baker-FRC)
W82-03892

WATERBORNE GASTROENTERITIS DUE TO THE NORWALK AGENT: CLINICAL AND EPIDEMIOLOGIC INVESTIGATION,
Texas Tech Univ., Amarillo.
R. Wilson, L. J. Anderson, R. C. Holman, G. W. Gary, and H. B. Greenberg.
American Journal of Public Health, Vol 72, No 1, p 72-74 January, 1982.. 1 Fig, 6 Tab, 4 Ref.

Descriptors: *Human diseases, *Drinking water, *Viruses, Epidemiology, *Gastroenteritis, *Norwalk agent, Public health, Waterborne diseases.

An investigation was made of an outbreak of gastroenteritis associated with evidence of infection with Norwalk agent. It was determined that respiratory symptoms were a prominent feature of the illness and that short-term natural immunity probability exists after infection with this agent. The outbreak occurred at a Pennsylvania summer camp in July of 1978. Illness was associated with the consumption of five or more glasses of water or water-containing beverages. Stool cultures were negative for bacterial pathogens; however, a fourfold or greater rise in titer of antibody to the Norwalk agent was noted in serum samples of three ill persons tested and in none of eight controls. Cooking facilities, waste disposal, and the camp water system were evaluated. Fluorescein dye tests gave no evidence of cross-contamination in the water system. Fecal coliforms were detected in unchlorinated well water, increased fecal streptococci in kitchen tap water, and increased total coliforms in water from the end of the line. No chlorine residual was present at the end of the line. (Baker-FRC)
W82-03898

THE UTILITY OF DIATOM ANALYSES OF LAKE SEDIMENTS FOR EVALUATING ACID PRECIPITATION EFFECTS ON DILUTE LAKES,
State Univ. of New York Coll. at Osewgo. Dept. of Earth Sciences.
A. Del Prete, and C. Schofield.
Archive fur Hydrobiologie, Vol 91, No 3, p 332-340, 1981. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *Acidic water, *Diatoms, Sediment cores, *Lake sediments, Pollutant identification, Honnedaga Lake, Woodhull Lake, Seventh Lake, *New York, *Water pollution effects.

The ratio of acid-loving to alkaline-loving diatoms present in sediment cores of 3 Adirondack mountain lakes indicated a time averaged history of lake acidification. The 3 lakes had varying pH as measured in July 1976: Honnedaga Lake, 4.7; Woodhull Lake, 5.2; and Seventy Lake, 6.5. An equation to calculate pH from the diatom indices gave inferred pH values of surface sediments of the lakes as follows: Honnedaga, 5.6; Woodhull, 5.9; and Seventh, 6.4. According to the sedimentation rates and diatom ratios in Honnedaga, marked acidification took place 10 years ago (from 6.2 to 5.6), consistent with the known history of acidification in the lake. No marked acidification or change in diatom indices was seen in the other two lakes, which averaged pH values of 6.1 (Woodhull) and 6.4 (Seventh) throughout the core length. (Cassar-FRC)
W82-03903

IMPACT OF MINING ACTIVITIES ON WATER QUALITY IN WESTERN NORTH CAROLINA,
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
For primary bibliographic entry see Field 5B.
W82-03926

IMPACT OF THE 1979 ACCIDENT AT THREE MILE ISLAND NUCLEAR STATION ON RECREATIONAL FISHING IN THE SUSQUEHANNA RIVER,
Nuclear Regulatory Commission, Washington, DC.
C. R. Hickey, Jr.
NUREG-0754, March, 1981. 38 p, 16 Fig, 4 Tab, 27 Ref.

Descriptors: *Nuclear powerplants, *Sport fishing, *Water pollution effects, *Public opinion, Attitudes, *Radioactive wastes, Recreation, Water quality, Fish harvest, *Three Mile Island Nuclear Station, Susquehanna River, *Fish behavior, Pennsylvania.

Dynamics of the recreational fishery of the Susquehanna River near Three Mile Island Nuclear Station during the postaccident year of 1979 were compared with those of the 5-year preaccident period of 1974-1978. Monthly and annual fishing efforts essentially were normal during 1979, but harvests and indices of harvest success were at record low levels for 5 months after the accident. The monthly harvest indices gradually improved with time until normal levels were attained during the sixth postaccident month (September). The depressed harvests did not result from water quality, ecological, or radiological causes attributable to the accident. Changes in angler harvest behavior and low retention rates for all the major fishery species were the major contributors to the poor harvest of 1979. Those changes were attributed to the anglers' awareness of the accident and to their concern with or perception of reduced environmental quality of the river, and of fish quality after the accident. The gradual recovery of the monthly harvest indices to normal levels followed the same general trend as the perception of threat and concern with emissions felt by the people living near Three Mile Island. Although the 1979 annual harvest was poor and most of the fishing year was disrupted, recovery during the same year along with normal levels of fishing effort suggest that the accident-related effects on the fishery were temporary. (Moore-SRC)
W82-03962

POWER PLANT SITING AND DESIGN: A CASE STUDY OF MINIMAL ENTRAINMENT AND IMPINGEMENT IMPACTS AT DAVIS-BESSE NUCLEAR POWER STATION,
Nuclear Regulatory Commission, Washington, DC.
C. R. Hickey Jr.
NUREG-0720, December, 1980. 43 p, 4 Fig, 12 Tab, 36 Ref, 1 Append.

Descriptors: *Nuclear powerplants, *Environmental effects, *Fish, Entrainment, Impingement, In-

takes, Cooling water, Larvae, Fish eggs, Design criteria, *Lake Erie, Ohio.

Fish impingement and ichthyoplankton entrainment were studied during 1977 and 1978 at the Davis-Besse Nuclear Power Station, located on the southwestern shore of Lake Erie, Ohio. The estimated losses of impinged fishes plus the 'equivalent adults' of entrained eggs and larvae were small fractions of the recreational and commercial fishery harvests from Ohio waters of Lake Erie. By comparison, the losses were 1-4 orders of magnitude less than at other Lake Erie power plants. The immediate site vicinity is not an important fish spawning or nursery area and appears to be in a relatively unproductive area of the western basin of Lake Erie. The closed-cycle intake design represents a practical balance between technological and ecological considerations, with minimal environmental impact. The impacts predicted in the preoperational environmental impact statements were reasonable and adequate in comparison with those actually observed during operation. The findings should provide useful information for the feedback process from operational experience to siting and design of future power plants on Lake Erie, and from operational experience to impact assessment and prediction.
W82-03964

PROGRESS REPORT ON THE EFFECTS OF SURFACE MINING ON THE SURFACE-WATER HYDROLOGY OF SELECTED BASINS IN THE FORT UNION COAL REGION, NORTH DAKOTA AND MONTANA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 4C.
W82-03975

EFFECT OF SEDIMENT COPPER ON THE DISTRIBUTION OF BENTHIC MACROINVERTEBRATES IN THE KEWEENAW WATERWAY,
Michigan Technological Univ., Houghton. Dept. of Biological Sciences.
K. J. Kraft, and R. H. Sypniewski.
Journal of Great Lakes Research, Vol 7, No 3, p 258-263, 1981. 1 Fig, 3 Tab, 29 Ref.

Descriptors: *Invertebrates, *Copper, *Sediments, *Water pollution effects, Benthic fauna, Toxicity, Species diversity, Lake Superior, Macroinvertebrates, *Particle size, Lakes, Mayflies, Mollusks, Crustaceans, Oligochaetes, *Keweenaw Waterway, Mine wastes.

The effects of copper and sediment particle size on benthic macroinvertebrates were investigated in two areas of the Keweenaw Waterway, connecting two areas of Lake Superior. Sediments from the north area, downdrift from deposits of copper tailings in the lake, averaged 66% silt and clay and 589 mg per kg Cu. The south area sediments averaged 27% silt and clay and 33 mg per kg Cu. The south area had 4.3 times more macroinvertebrates than the north area. Average taxa numbers per station were 20 at the south stations and 8 at the north stations. Total taxa in the south were 51, in the north 31. Both areas had 26 taxa in common. Four taxa collected only in the north were represented by only 5 individuals; 25 taxa collected only in the south were represented by 1007 individuals. Most common invertebrates in the south were mayflies (31%) and in the north Dipterans (54%). Oligochaetes were second in abundance in both areas, 31% in the south and 43% in the north. No mollusks and 2 individual crustaceans were found in the north, but 7 genera and 101 individual molluscs and 3 genera and 646 individual crustaceans were found in the south. Sediment particle size appeared to have no effect on macroinvertebrate distribution. (Cassar-FRC)
W82-04030

ATTACHED ALGAE OF THE LAKE ERIE SHORELINE NEAR NANTICOKE GENERATING STATION,
M. K. Kirby, and W. E. Dunford.
Journal of Great Lakes Research, Vol 7, No 3, p 249-257, 1981. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Algae, *Powerplants, *Thermal pollution, *Lake Erie, *Water pollution effects, Cladophora, Zygnema, Nanticoke Generating Station, Species composition, Standing crops, Spatial distribution, Cooling water, Thermal discharges.

The effects of the construction and operation of the Nanticoke Generating Station, a coal-fired power plant on the Lake Erie shore, on the distribution, species composition, and standing crop of attached algae were studied from 1971 to 1978. Sampling was done at 8 lakeshore sites considered outside in the influence of the power plant and at 8 sites in the immediate vicinity of the plant's thermal discharge. Algae near the station had accelerated growth early in the season, but this did not continue after May. This was attributed to the effect of the thermal discharge, which was generally 2-4 C higher than ambient temperatures. Cladophora were less abundant and weakly attached algae such as Zygnema were more abundant near the generating station, probably as a result of the sheltered bay created by construction of the plant. Algal spatial distribution was unaffected by the presence of the power station. (Cassar-FRC)
W82-04035

PERIVITELLINE PH OF SALMONIDE EGGS IN RELATION TO AMBIENT PH,
Uppsala Univ. (Sweden). Inst. of Zoophysiology.
N. Johansson, P. Runn, and M. Sohtell.
Water Resources Bulletin, Vol 17, No 6, p 994-999, December, 1981. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Fish eggs, Eggs, *Acidic water, *Water pollution effects, Salmon, Trout, *Hydrogen ion concentration.

Fertilized eggs from slamon and brown trout were raised in water of pH levels 4.1, 4.4, 4.8, 5.0, 5.8, and 7.2. In the more acidic waters (4.1-4.7 pH) the pH of the perivitelline fluid, measured at different stages of development up to 85 days, was higher than the pH of the ambient water, 0.4 units in salmon eggs and 1.0 units in trout eggs. In adult fish acidic water is believed to stress the ion regulation mechanisms, resulting in a reduction of accumulation of ions or a loss of ions. Since ion accumulation is active in the later stages of egg development, embryos and subjected to stress in acidic water even before hatching. Further stress occurs when the eggs hatch and the fry enter water more acidic than the perivitelline fluid. Thus even short episodes of low pH, such as in spring snowmelt, can affect developing embryos. (Cassar-FRC)
W82-04064

INFLUENCE OF FOREST AND RANGELAND MANAGEMENT ON ANADROMOUS FISH HABITAT IN WESTERN NORTH AMERICA; 8. EFFECTS OF MINING,
Intermountain Forest and Range Experiment Station, Boise, ID.
S. B. Martin, and W. S. Platts.
Forest Service General Technical Report PNW-119, April, 1981. 18 p, 74 Ref.

Descriptors: *Aquatic environment, *Environmental effects, Mining, *Water pollution, *Mine drainage, *Streamflow, *Anadromous fish, Mine wastes, Suspended sediments, Acid mine drainage, Heavy metals, Toxicity, *Forest management, Ecological effects, Range management.

About 68% of the 743.2 million acres of public land in the U.S. is open to mining. Mining can pollute the aquatic environment by producing sediment, changes in pH, toxic heavy metals, and alterations in stream channel and streamflow. Deposition of excessive fine sediment on the stream bottom eliminates habitat for aquatic insects; reduces the biomass and diversity of aquatic insects; reduces the permeability of spawning gravels; and blocks the interchange of surface and subsurface waters. Suspended sediments may reduce photosynthesis, and affect fish migration, feeding, and respiration. Acid is a major pollutant from mine drainage. Acid mine drainage occurs when pyritic material, usually associated with mining coal and heavy metals, is oxidized to produce ferrous sulfate and sulfuric acid. This results in a pH range of 2.0-4.5 in receiving waters, levels toxic to many forms of aquatic life. In the West, problems may arise from alkaline drainage. Dissolved heavy metals, commonly found in waters polluted by mine drainage, are toxic to the aquatic biota. In general, fish mortality results from exposure to high metal concentrations, but continuous low exposure produces chronic effects, such as behavioral changes, reproductive failure, or fry mortality. Mining operations can result in increased erosion and sediments, and may lead to increased streamflows. Direct use of water in milling and mining operations may decrease stream flows. Pollution from abandoned mines can be as much of a problem as from mines that are active. (Moore-SRC)
W82-04071

INFLUENCE OF FOREST AND RANGELAND MANAGEMENT ON ANADROMOUS FISH HABITAT IN WESTERN NORTH AMERICA; 7. EFFECTS OF LIVESTOCK GRAZING,
Intermountain Forest and Range Experiment Station, Boise, ID.
W. S. Platts.
Forest Service General Technical Report PNW-124, April, 1981. 28 p, 86 Ref.

Descriptors: *Grazing, *Aquatic environment, *Environmental effects, *Water quality, Streamflow, Channel morphology, *Anadromous fish, Range management, Stream banks, Riparian vegetation, Water pollution, Erosion, Livestock, *Forest management, Fish populations, Ecological effects.

Livestock grazing can affect all components of the aquatic system. Grazing can affect the streamside environment by changing, reducing, or eliminating vegetation bordering the stream. Channel morphology can be changed by accrual of sediment, alteration of channel substrate, disruption of the relation of pools to riffles, and widening of the channel. The water column can be altered by increasing water temperature, nutrients, suspended sediment, bacteria, and in the timing and volume of streamflow. Livestock can trample streambanks causing banks to slough off, creating false setback banks, and exposing banks to accelerated soil erosion. Streams and streamside zones are most critical for multiple-use planning and offer the greatest challenge for proper management; stream habitats, therefore, should be identified as separate management units to receive intensified management. Proper management of livestock will increase resource values and, in turn, economic benefits to all users. A short-term loss of forage for livestock may occur when overused and degraded reparian communities are put under proper management, but increased forage production should ultimately be a result of improved resource management. (Moore-SRC)
W82-04072

TOXIC SUBSTANCES MONITORING PROGRAM - 1980,
California State Water Resources Control Board, Sacramento.
For primary bibliographic entry see Field 5A.
W82-04077

WATER QUALITY AND OFF-FLAVOR PROBLEMS IN COMMERCIAL CHANNEL CATFISH CULTURE IN WEST-CENTRAL ALABAMA,
Auburn Univ., AL.
S. W. Brown.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-198078, Price codes: A03 in paper copy, A01 in microfiche. MS Thesis, June 1981. 34 p, 6 Fig, 3 Tab, 28 Ref, 2 Append. OWRT B-076-ALA(9).

Descriptors: *Catfish, Total ammonia nitrogen, Chemical oxygen demand, Feeding rates, Ammonia, Nitrogen, Nitrites, *Water quality, *Fish farming, Fishfood, *Alabama.

Total ammonia nitrogen (TAN), nitrite-nitrogen, chemical oxygen demand (COD), and chlorophyll alpha concentrations were measured twice monthly during the 1980 growing season in 24 commer-

cial catfish ponds in Western Alabama. Nitrite-nitrogen ranged from 0.94 - 3.50 mg/liter during or shortly after cases of nitrite poisoning (brown blood disease) that resulted in high mortality in four ponds. Three cases developed within a week after algicides were applied to ponds to thin plankton blooms. Intracellular nitrite can accumulate when phytoplankton are rapidly reducing nitrate. It is likely that high concentrations of nitrite can leach from phytoplankton cells when sudden phytoplankton die-offs occur. Feeding rates were high in all ponds where excessive nitrite levels developed. The degree of off-flavor in catfish was correlated with maximum daily feeding rate, suggesting that high feeding rates increase the intensity of off-flavor. However, fish from ponds with low feeding rates usually had a discernible off-flavor. The best tasting fish were obtained from a pond that was turbid with suspended clay particles from July 1 until harvest. Lyngbya sp. and Scenedesmus sp. were associated with off-flavor. There was no correlation between numbers of blue-green algae and the degree of off-flavor in catfish.
W82-04087

A FLUORIDE OVERFEED INCIDENT AT HARBOR SPRINGS, MICHIGAN,
Michigan Dept. of Public Health, East Lansing.
D. E. Leland, K. E. Powell, and R. S. Anderson, Jr.
Journal of the American Water Works Association, Vol 72, No 4, p 238-243, April, 1980. 6 Fig, 4 Tab, 3 Ref.

Descriptors: *Fluorides, *Water pollution effects, Public health, Epidemiology, *Fluoride overfeed, *Harbor Springs, *Michigan, Water pollution sources, Water quality control, Water treatment, Water distribution, Toxicity, Pumping plants, Wells, Path of pollutants.

The first reported occurrence of illness resulting from a malfunctioning community fluoridation system occurred on November 22, 1977, at Harbor Springs, Michigan. Four persons experienced vomiting or nausea after drinking metallic-tasting water containing up to 2400 mg fluoride per liter. The high fluoride levels were a result of a hydrofluosilicic acid overfeed. Subsequent investigations indicated a probable chain of events. The Stadium well, normally dormant in winter, was briefly operated for unknown reasons on November 1, at which time the fluoride cutoff switch failed to operate, causing the remaining contents of the chemical drum (86 kg) to enter the discharge line. On November 22 a felled tree interrupted the reservoir signal and turned on all wells simultaneously for about 90 sec. At this time the fluoride in the line entered the distribution system, producing fluoride levels, estimated by CaCl2 experiments, at 1700 mg per liter in the city hall area and 2400 mg per liter at a medical care facility. Inspection of the Stadium fluoride feed system revealed that the control mechanism had not turned off. It was not electrically connected to the well motor in accordance with normal practice in newer wells. Recommendations included: (1) electrical interconnection of chemical feed equipment with pumping equipment, (2) disconnection of feed equipment for nonessential chemicals in rarely used wells, (3) frequent inspection of standby equipment, (4) education of water utility personnel to collect samples during flushing operations, and (5) notification of customers and health officials by telephone, radio, etc., as soon as possible after an emergency. (Cassar-FRC)
W82-04147

MINERAL DYNAMICS OF THE SUBMERSED MACROPHYTE, MYRIOPHYLLUM HETEROPHYLLUM, AND THE COMPETITIVE INTERACTIONS FOR NUTRIENTS BETWEEN M. HETEROPHYLLUM, PHYTOPLANKTON AND THE SEDIMENTS IN LITTORAL WATERS,
New Hampshire Univ., Durham. Dept of Botany.
K. D. Kimball, and A. L. Baker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-202094, Price codes: A06 in paper copy, A01 in microfiche. Research Report No 35, August 1981. 111 p, 28 Fig, 11 Tab, 113 Ref. A-052-NH(2), 14-34-0001-9031.

Descriptors: *Nuisance, Infestations, *Lakes, *Dominant minerals, *Hydrophytes, Lake Winnipesaukee, Phytoplankton, Sediments, Littoral zone, Nutrients, *Myriophyllum heterophyllum, *Emergent floral stem, *Oxygen floral stem, *Oxygen, *Oxidizing enzymes.

Myriphyllum heterophyllum is a nuisance, submersed hydrophyte in New Hampshire. First observed in Lake Winnipesaukee, N. H. during the 1960's the plant infested over 22 miles of the lake's shoreline by 1980. Lake Winnipesaukee now acts as a source for new infestations elsewhere in the region. The emergent floral stem, apex, sub-apex, mid-stem, lower stem, and roots of M. heterophyllum were analyzed for ash, P, Na, K, Ca, Mg, Fe, Mn, Zn, Cu, and Pb from June 1979 through July 1980 at two sites in Lake Winnipesaukee. Na and K were the dominant minerals, with the exception of Ca in the floral spike and Fe in the roots. Na concentrations were highest in the stem. The structural role and slow mobilization in the phloem of Ca explain its high concentration in the floral stem. Root losses or oxygen and oxidizing enzymes cause the formation of a sheath of precipitated iron on the roots. M. heterophyllum's mineral requirements are not fulfilled by previous storage or luxury uptake. Rather, the data suggest that M. heterophyllum immediately mobilizes minerals from nutrient rich sediments to meet nutrient needs. From 1977-1979 the competitive interactions between M. heterophyllum, phytoplankton and sediments in the littoral zone of Lake Winnipesaukee were examined. Changes in the littoral zone of Front Bay, Lake Winnipesaukee, before and after continuous nutrient additions from nutrient rich sewage treatment plant effluent were also monitored. The results suggest that nutrient levels in the water determine submersed macrophyte versus phytoplankton dominance in the littoral zone and the littoral sediments' capacity to sorb phosphorus is a critical factor in regulating nutrient availability in the water.
W82-04162

BACTERIAL CONTROL OF AQUATIC ALGAL POPULATIONS--PHASE II,
Medical College of Ohio at Toledo. Dept. of Microbiology.
J. C. Burnham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-202060, Price codes: A07 in paper copy, A01 in microfiche. Report No 529028, January 1981. 122 p, 8 Fig, 3 Tab, 56 Ref, 1 Append. OWRT-B-072-OHIO(1).

Descriptors: *Algal control, Aquatic bacteria, Bacteria, Bdellovibrio, Cyanophyta, Ecology, Myxobacteria, Phormidium, Predation, Water pollution control, Algae.

Experiments are described utilizing the bacterial species Bdellovibrio bacteriovorus and Myxococcus xanthus to inhibit and subsequently lyse the cyanobacterial species, Phormidium luridum. Culture supernatants of B. bacteriovorus were shown to inhibit the photosynthetic activity of the cyanobacterium. A low molecular weight component of yeast extract was found capable of causing photooxidation in an oxygen electrode system. Because this mimics cell respiration, experiments employing yeast extract in electrode systems must be carefully controlled. This photoactive agent had no direct effect on P. luridum. The inhibition of the photosynthetic system and lysis of the cyanobacterium depended upon high environmental protein concentrations. The bacterium Myxococcus xanthus was found to be a much more effective agent for cyanobacterial lysis. Lysis of the cyanobacteria occurred within colonial spherules formed by the myxococcal cells. Predator-to-prey ratios of 1/10, 1/100 and 1/1000 have resulted in cyanobacterial lysis. Most significantly the lytic effect of the myxococcal colonies on the cyanobacterium appears indpendent of any environmental heterotrophic nutrient source. Electron microscopy is used to illustrate the ultrastructural phenomena associated with this ecological interaction.
W82-04163

DISTRIBUTION OF MUTAGENS IN TAMA AND AYASE RIVER SEDIMENTS,
Tokyo Univ. (Japan). Faculty of Pharmaceutical Sciences.
For primary bibliographic entry see Field 5A.
W82-04182

WATERBORNE GIARDIASIS--AN OVERVIEW,
Williamsport Sanitary Authority, PA.
M. H. Gerardi.
Public Works, Vol 113, No 1, 60-63, January, 1981. 1 Fig, 5 Tab, 17 Ref.

Descriptors: *Diseases, *Giardiasis, *Filtration, *Water treatment, *Water pollution effects, Water pollution sources, Parasites, Feces, Epidemiology, Cysts, Chlorination, Public health, Fate of pollutants, Protozoa, Disinfection, Surface water, *Waterborne diseases.

Giardiasis is a waterborne intestinal disease caused by the flagellated protozoan parasite Giardia lamblia. Since the late 1960s 1 to 4 outbreaks of this disease have been recognized each year in the U.S., accounting for 22% of all waterborne illnesses. Giardiasis is acquired from drinking water contaminated with infected feces, either human or wild animal. The Giardia lamblia two-stage life cycle consists of a reproductive trophozoite and a dormant but inefective cyst. The cysts' survival periods are 4 days in 37 C water, one month in 21 C water, 2 months in 8 C water, and 2 weeks in a moist environment. Intestinal and digestive problems appear 1 to 8 weeks after ingestion. The acute phase may last 2 or 3 months. Some persons are asymptomatic. Communities most likely to have giardiasis outbreaks use surface water. Reservoir bottom water contains the greatest cyst concentrations. Giardia is resistant to chlorination; no safe and effective level of chlorine residual can be recommended for all water types. Cysts can be removed from water supplies by proper filtration, either diatomaceous earth, coagulation plus rapid granular media filters, or sand. A critical period during which cysts may pass through the filter is the 30 min immediately following backwash. Sludge, which may contain a high concentration of cysts, must be properly disposed of. Once a water supply is contaminated it may remain so for several months. Use of alternate water supplies or boiling drinking water for 1 min will provide safe water until the treatment system can be adjusted to control the problem. (Cassar-FRC)
W82-04186

PRIMARY PRODUCTION IN A EUTROPHIC ACID LAKE,
West Virginia Univ., Morgantown. Dept. of Biology.
G. A. Shellito, and J. Decosta.
Water, Air, and Soil Pollution, Vol 16, No 4, p 415-431, 1981. 10 Fig, 8 Tab, 52 Ref.

Descriptors: *Lakes, *Eutrophication, Nutrients, *Phosphorus, Algal growth, Acidity, *Hydrogen ion concentration, Precipitation, *Tibbs Run Lake, *West Virginia.

The objectives of this study were to measure hydrogen ion concentration and phosphorus in the bulk precipitation over Tibbs Run Lake, to construct nutrient budgets and a hydrogen ion budget for the lake, and to determine the lake trophic status by measuring chlorophyll concentrations and primary production. Water samples were taken biweekly from March 10, 1977 to March 11, 1978, with the exception of the winter months, when samples were obtained monthly. Samples were collected at each meter, surface to bottom. Tibbs Run Lake is small, shallow and located 10 km east of Morgantown, West Virginia. The lake has an area of about 6.36 ha, a maximum depth of 4.5 meters and a mean depth of 2.0 meters. The single inflow to the lake is Tibbs Run, partially diverted to the lake by a concrete conduit from a concrete dam and located about 100 meters from the lake. The major source of hydrogen ion was the stream input. Total phosphorus in bulk precipitation ranged from 6.4 to 190 mg/cubic meter. The mean total phosphorus concentration was 27 mg/cubic meter. The maximum chlorophyll concentration of 211 mg/square meter occurred on September 16, 1977. Chlorophyll concentrations were

highly correlated with total phosphorus. This suggests that phosphorus is the primary nutrient required for algal growth in Tibbs Run Lake. (Baker-FRC)
W82-04192

AQUACULTURAL APPROACHES TO RECYCLING OF DISSOLVED NUTRIENTS IN SECONDARILY TREATED DOMESTIC WASTEWATERS--II. BIOLOGICAL PRODUCTIVITY OF ARTIFICIAL FOOD CHAINS,
California Univ., Davis. Dept. of Biology.
For primary bibliographic entry see Field 5D.
W82-04197

STORM-SEWER INPUT OF HEAVY METALS INTO AN URBAN LAKE ENVIRONMENT,
Western Michigan Univ., Kalamazoo. Dept. of Science Education.
For primary bibliographic entry see Field 5A.
W82-04207

5D. Waste Treatment Processes

A COMPARISON OF CHLORINE AND CHLORINE DIOXIDE DISINFECTION OF WASTEWATER EFFLUENTS: THE GENERATION OF SELECTED HALOHYDROCARBONS,
Rutgers - The State Univ., New Brunswick, NJ. Graduate Program in Environmental Science.
M. E. Buzby.
PhD Thesis, October, 1980. 220 p, 45 Fig, 16 Tab, 151 Ref, Append. University Microfilms International, Ann Arbor, MI: Order No. GAX81-04988.

Descriptors: *Wastewater treatment, *Chlorination, *Disinfection, *Chemical reactions, Organic compounds, Domestic wastes, Industrial wastes, Bromine, Halogens, Chlorine, Chlorine dioxide, Comparison studies.

Twenty-two halogenated volatile compounds that were considered possible products of the reaction of wastewater with chlorine or chlorine dioxide in the concentration range normally applied during wastewater disinfection of secondary effluents were selected and studied during this research. Because industrially generated wastewaters may contain a wider range of chemical compounds in larger concentrations than domestic wastewater, effluents that ranged from strictly domestic to 50% industrial were studied. Parallel tests were conducted in which wastewaters were dosed with either sodium hypochlorite or chlorine dioxide in the same concentration range. Further work was done to establish if the halogenated compounds were generated by the reaction of chlorine or chlorine dioxide with very dilute solutions of 1,2-dichloroethylene, styrene monomer, vinyl acetate and ethyl alcohol. The reactions of these widely used chemicals were studied to elucidate the participation of bromide ion in the chemistry of chlorination and to establish the comparable susceptibility of common chemical structures to reaction with the chlorine compounds. It was established that chlorine dioxide is preferred to chlorine for disinfection of some wastewater effluents. Both disinfectants reacted with effluents from both domestic and industrial sources to generate the halogenated compounds. Chlorine dioxide does not form brominated products although it was observed that the presence of bromide ion in the reaction mixtures can influence the products of chlorine dioxide's interactions in aqueous solutions. (Sinha-OEIS)
W82-03751

A STOICHIOMETRIC MODEL OF BACTERIAL GROWTH,
Exxon Research and Engineering Co., Florham Park, NJ.
R. W. Dennis, and R. L. Irvine.
Water Research, Vol 15, No 12, p 1363-1373, December, 1981. 6 Fig, 4 Tab, 46 Ref.

Descriptors: *Bacteria, *Biological wastewater treatment, *Model studies, Biomass, Mathematical studies, Kinetics, *Activated sludge process, Growth, Microbiological studies.

A model of bacterial growth is developed, based upon the premise that a heterotrophic culture of bacteria will react with a carbonaceous substrate in the presence of oxygen and nutrients to produce more bacteria, carbon dioxide, water, various shunt products and storage products. The biomass is structured into three components: active biomass, stored biomass, and inert biomass. Three soluble components are considered: primary substrate, a secondary, shunted, biodegradable substrate, and a shunted non-biodegradable substrate. Stoichiometric coefficients and rate forms have been proposed for the formation of each of these components and for the rate of oxygen utilization. The model is shown to be effective in simulating the step response to a recycle reactor, a batch test with a high initial substrate concentration and the step response of a chemostat. Critics of structured, stoichiometric models may argue that the kinetic coefficients are too difficult to evaluate for a given system and therefore the models have little practical significance. However, by attempting to quantify natural phenomena, such as storage and shunt, in biological waste treatment systems, a practitioner may be led directionally toward an operating policy that would otherwise be overlooked. (Baker-FRC)
W82-03756

OPERATIONAL ESTIMATION AND PREDICTION OF NITRIFICATION DYNAMICS IN THE ACTIVATED SLUDGE PROCESS,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
M. B. Beck.
Water Research, Vol 15, No 12, p 1313-1330, December, 1981. 7 Fig, 4 Tab, 64 Ref.

Descriptors: *Activated sludge process, *Nitrification, *Model studies, Sludge, *Wastewater treatment, Mathematical studies, Automation, Kalman filter, *Norwich Sewage Works, *Great Britain, Systems engineering.

A study on modelling and operational control of the activated sludge process is illustrated by reference to the plant at Norwich Sewage Works. An on-line, recursive estimation algorithm, the extended Kalman filter, has been applied to the two problems of examining the feasibility of state estimation and state reconstruction as features of operational control and the evaluation of the use of a model for on-line prediction of short-term variations in future operating conditions. The dynamic model of Poduska & Andrews for nitrofication in the activated sludge process has been employed. Considerations of uncertainty and the possibility of rapid major perturbations in performance due to spillages of toxic substances or the loss of solids over the clarifier weir are of special importance to the discussion. The performance of the model and the estimation algorithm were reasonably good. However, the model is limited in its ability to characterize nitrifier growth, principally due to the assumption that growth rate is independent of dissolved oxygen concentration. The growth rate is further assumed to be independent of dissolved oxygen concentration. The growth rate is further assumed to be independent of the mixed liquor suspended solids concentration, and the model does not characterize the dynamics of the secondary clarifier. Such models have potential for examining interacting characteristics of the activated sludge process, and thus they aid in operation control efforts. Such models will also help detect non-ideal operating conditions and thus perhaps avert accidental spillages of toxic materials or adverse changes in sludge characteristics. (Baker-FRC)
W82-03759

EVALUATION OF THERMODYNAMICAL EFFICIENCY OF REVERSE OSMOSIS PROCESS USING ENTROPY,
National Inst. for Environmental Studies, Yatabe-Machi, Ibaraki (Japan).
T. Goda, S. Tai, and A. N. Yamane.
Water Research, Vol 15, No 12, p 1305-1311, December, 1981. 4 Fig, 5 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Water treatment, *Desalination, Evaluation, Thermodynamics, *Entropy, *Reverse osmosis, Mathematical studies, Performance evaluation.

Entropy is the measure of disorder of a system and as such should be considered an important index for system performance, e.g., in water and wastewater treatment. The direction of water quality change can be observed through entropy in thermodynamic interpretations. The change in water quality causes a difference between output entropy and input entropy. In the chemical separation systems, the change in water quality is symbolized as the difference in entropy of mixing before and after treatment. The calculation of internal entropy production in water treatment systems should be based on a series of mathematical equations from the nonequilibrium thermodynamics. The efficiency of system performance is calculated from the decrease in entropy of feed water per unit time and the rate of interanl entropy production in the water treatment system. In a closed system, entropy tends to increase. When a compound is dumped in pure water, it is likely that the compound will be dissolved and diffused into the whole water body. The implication of the compound dissolving and diffusing in the water are twofold: increase in entropy of the solution, and increase in the extent of pollution. Increased entropy is thus equivalent to water pollution. Once the water is polluted, energy input is required to remove pollutants and purify the water in order to decrease the entropy of the aqueous solution. (Baker-FRC)
W82-03760

MEASUREMENT AND CONTROL OF THE MLSS CONCENTRATION IN ACTIVATED SLUDGE PLANTS,
Niersverband, Viersen und Emschergenossenschaft, Essen (Germany, F.R.).
J. Lohmann, and S. Schlegel.
Water Science and Technology, Vol 13, No 9, p 217-224, 1981. 6 Fig, 1 Tab, 6 Ref.

Descriptors: *Activated sludge process, *Automation, Computers, *Wastewater treatment, Wastewater facilities, Monitoring, Measuring instruments, Mixed liquor suspended solids.

Experience with mixed liquor suspended solids (MLSS) measurement and control is presented. The essential control strategies are: sludge load or food/microorganism ratio, and sludge age or sludge retention time. Both are directly connected. The efficiency of the final sedimentation is above all determined by the parameters of surface load, sludge volume load, and return sludge ratio. The required return activated sludge rate is determined by the dry solids concentration attainable in the return sludge, which is in turn dependent on the thickening quality of the activated sludge and the conditions prevailing as a result of the mechanical and construction design of the final concentration in return sludge, and vice-versa. A strong and rapid increase in the wastewater inflow, for example resulting from rainfall, increases the hydraulic load of the final sediment, resulting in an increase in the activated sludge volume held in suspension in the final sedimentation tank. This causes a reduction in the MLSS concentration in the aeration tank. If the hydraulic load decreases, activated sludge precipitates more intensively in the final sedimentation and is carried by the return sludge back into the aeration tank, where it leads to an increase in the MLSS concentration. Up to the present time only a few treatment plants in Germany have been equipped with a control system for the MLSS content, since no suitable measuring devices were available. Now, however, the experience gained with the automatic discharge of surplus sludge and control of the MLSS concentration suggests that the set point can be adhered to with appreciably more accuracy than in the case of manual operation. (Baker-FRC)
W82-03762

DISTRIBUTED CONTROL SYSTEM 'AQUAMAX-80' SERIES FOR MANAGING WASTEWATER SYSTEMS,

Hitachi Ltd (Japan).
N. Tsuchiya, T. Kasai, and S. Mori.
Water Science and Technology, Vol 13, No 10, p 439-444, 1981. 7 Fig, 1 Tab.

Descriptors: *Wastewater management, *Process control, *Digital computers, *Automation, *Wastewater treatment, Monitoring, Computers, Water quality control, Data processing, Data transmission, Electronic equipment.

The AQUAMAX-80, a new digital computerized distribution control system for wastewater management, is described. The control monitoring and distribution system is equipped with color displays and handles the prediction of wastewater quality using models for dissolved oxygen (DO), mixed liquor suspended solids (MLSS), chemical oxygen demand (COD) and others. The distributed microcontrollers which are connected to the central mini-computers by data net works monitor local systems such as pumps, DO, MLSS, sludge draw, blowers and sludge treatment. The AQUAMAX-80 comes in three models to suit different size operations, and all three represent the most sophicated automated equipment available for the electronic control of wastewater treatment processes. Such systems offer central management plus distributed control, manual or machine operation, line sharing data transmission and digital control with programmable controllers. Some advantages of the digital over the conventional analog system are discussed. (Geiger-FRC)
W82-03763

MIXED BED TECHNOLOGY FOR POLISHING MAKE-UP WATER AND CONDENSATE RETURN: CONCLUSION,
Rohm and Haas Ltd., Croydon (England).
R. A. F. Scott.
Effluent and Water Treatment Journal, Vol 21, No 4, p 175-178, 180-182, April, 1981. 4 Fig, 2 Tab, 30 Ref.

Descriptors: **Ion exchange, *Condensates, *Water purification, Water treatment, *Cooling water, Return water, Boiler water, Ammonia, Sodium, Resins, Regeneration, Cation exchange, Anion exchange, Water reuse.

An essential role for a mixed bed polisher is to remove ionic contaminants from cooling-water condensate. The greatest ionic concentration is due to ammonia added to maintain the desired pH level. The next main concentration is sodium and chloride, along with calcium, magnesium, sulfate and silica. Additional ionic leakage will include silica, organics and some soluble corrosion products such as iron, copper and nickel. Great progress has been made over the past 30 years in the field of condensate polishing on high flow rate mixed beds. One problem has been to find a technique which allows the ammonium ions to pass through unchanged while at the same time completely removing unwanted ions such as sodium. During recent years leakage values of the order of 1 ppb or less have been regularly reported for sodium and chloride ions from certain installations. Interest has recently been stirred in sulfuric acid leakage from CP mixed beds. Unexpectedly high sulfate leakages have been reported from freshly regenerated units, in the range of 10 ppb, decreasing to a steady state value of 1 to 3 ppb after several hours, depending on the age of the anion resin concerned. Several processes have been developed to help improve the separate resin regeneration methods. The presence of the sodium form cation resin in the anion regeneration vessel is a major source of sodium leakage from a polishing mixed bed run past the ammonia break point. The use of ammonia solution to convert the sodium form cation resin to the ammonium form has been well studied. As an alternative to the ammoniation of the anion resin, the use of a lime solution has been suggested to convert the sodium cation contamination to the calcium. The debate on choice of gel versus macroreticular resins for the filtration and deionization of condensate by high flow rate naked deep polishing mixed beds is briefly noted. (Cassar-FRC)
W82-03774

THE GROWING BUSINESS OF BACTERIAL CULTURES,
C. S. Hyde.
BioCycle, Vol 22, No 6, p 25-27, November/December, 1981.

Descriptors: *Wastewater treatment, *Bacteria, Cultures, *Microorganisms, *Oil spills, Water pollution control, *Industrial wastes.

Treatment with mutant bacteria appears to be the trend in spill control and cleanup of organic waste dumps. This was shown to be effective in cleaning up soils and beaches contaminated by crude oil. Its use for treatment of industrial wastewaters in existing biological treatment plants is well known. Users range from many large companies to small food processors faced with more stringent effluent BOD requirements. Production of these bacteria consists of collecting microorganisms from nature, growing the organisms in a medium containing the specific compound or fix the adaptation. The adapted, mutant microorganisms are then grown in quantity and preserved in a dormant state, to be reconstituted with water just prior to use. Carefully planned application programs are critical to the field. It may take many years for naturally occurring bacteria to digest some spilled organic wastes, particularly under uncontrolled ambient conditions. The addition of pre-selected, adapted bacteria, under the proper, reasonably controlled conditions, accomplishes in days what would otherwise take years. In water treatment systems, the addition of such strains allows the necessary biomass adjustments to be accomplished in minutes rather than in days. (Baker-FRC)
W82-03786

BREAKTHROUGH CHARACTERISTICS OF SELECTED TOXICANTS IN GRANULAR ACTIVATED CARBON TREATMENT OF COMBINED INDUSTRIAL WASTEWATERS,
Texas Univ. at Dallas, Richardson.
W. H. Vick.
PhD Thesis, August, 1981. 236 p, 36 Fig, 44 Tab, 99 Ref, Append. University Microfilms International; Ann Arbor, MI; Order No GAX81-26592.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Activated carbon, *Adsorption, *Toxins, Monitoring, Organic wastes, Hydrocarbons, Effluents.

The effects of competitive adsorption on removal of selected organic toxicants in fixed-bed granular activated carbon adsorbers were examined using bench scale adsorption systems. Carbon column effluents were monitored for breakthrough of substituted phenols, phthalic acid esters, chlorinated hydrocarbons, and polynuclear aromatic hydrocarbons spiked into distilled water and combined industrial wastewater matrices. In all adsorption matrices investigated, polynuclear aromatics and semi-volatile chlorinated hydrocarbons were found to be the most effective competitors for available adsorption sites. More efficient removal of these compounds was found to occur not only as a result of greater carbon affinity at mutually available adsorption sites, but also as a result of adsorption at sites not accessible to the other solutes. Competitive adsorption was found to result in decreased carbon capacity for individual solutes, accelerated initial breakthrough, a more rapid breakthrough rate, and desorption of lower affinity compounds. Effluents from carbon columns treating low spike level wastewater matrices were also monitored for breakthrough of surrogate organic parameters, including TOC, COD-digestion, and COD-UV correlation. Surrogate parameter breakthrough curves were found to be radically different than those exhibited by individual toxicants, severely limiting effective use of such parameters as carbon column monitoring tools. (Sinha-OEIS)
W82-03812

SELECTIVE CONCENTRATION AND ISOLATION OF AROMATIC AMINES FROM WATER,
Colorado Univ. at Boulder. Dept. of Chemistry.
H. A. Stuber.
PhD Thesis, 1980. 210 p, 37 Fig, 36 Tab, 85 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-14011.

Descriptors: *Wastewater treatment, *Separation techniques, Adsorption, Organic compounds, Aromatic compounds, Selectivity, *Aromatic amines, Selective concentration.

A new approach is investigated for selectively concentrating ionogenic organic compounds from water. Aromatic amines are adsorbed from water on columns of hydrophobic adsorbents and recovered by an ionizing, acidic elution. The method directly concentrates and isolates aromatic amines from other solutes without evaporation or use of organic solvents. Applicants are demonstrated for trace enrichment and for the separation of pure compound class fractions of complex wastewaters. The affinity of the sorbent for both the neutral and charged forms of solutes is important in determining the concentration effect attainable. A treatment of the theory of concentrations using column chromatography is presented. The potential of six neutral sorbents for selective concentration of amines was evaluated. A new procedure based on pH changes in the mobil phase and reversal of flow direction on a column is demonstrated for isolating a class of compounds as a pure fraction. The theory is presented, and the validity of the method shown by the separation of amines from neutral and acid solutes and by isolation of pure aromatic amine, phenol and acid fractions from oil shale retorting wastewaters. Results indicate that selective concentration methods are valuable in the analysis of complex wastewaters, and should be useful in collecting from trace levels in the hydrologic environment the ionogenic solutes which dominate the organic chemistry of synthetic fuel wastewaters. (Sinha-OEIS)
W82-03829

A RESUME OF THE KINETICS OF THE BOD TEST,
For primary bibliographic entry see Field 5A.
W82-03832

HOGSMILL VALLEY WORKS: TWENTY YEARS ON,
E. G. Eves.
Water Pollution Control, Vol 80, No 4, p 452-462, 1981. 1 Fig, 5 Tab.

Descriptors: *Activated sludge process, Sludge digestion, *Wastewater treatment facilities, Lagoons, *History, *Hogsmill Valley Works, *England.

The Hogsmill Valley Works, England, built in 1957, and designed to treat a daily water flow of 33 thousand cu m per day, processed a daily water flow of 56.7 thousand cu m per day in 1977-78. Some of the plant modifications carried out to increase capacity were: (1) a suction dredger system for grit removal, (2) short slot comminutors, (3) aeration in all channels of the activated sludge plant, (4) increase in rotational speed of sludge scrapers and installation of a 4-arm continuous scraper, (5) installation of a single expendable piston gas recircular and a Burper mixer in a sludge digester, and (6) improvements in the powerhouse. (Cassar-FRC)
W82-03834

OPERATIONAL EXPERIENCES IN THE EFFECTIVE TREATMENT OF EFFLUENTS FROM SYNTHETIC RESIN MANUFACTURE,
CIBA-GEIGY Ltd., Duxford (England). Plastic Div.
A. J. Housden.
Water Pollution Control, Vol 80, No 4, p 490-496, 1981. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Industrial wastewater, *Resins, *Wastewater treatment, Chemical wastewater, Phenol, Formaldehyde, Activated sludge process, Sludge disposal, *River Cam, Duxford, United Kingdom.

Synthetic resin plant wastewater (1270-1360 cu m per day), containing formaldehyde, phenol, metha-

nol, and resins, is successfully treated in admixture with domestic sewage (140-170 cu m per day) in an activated sludge plant. The resin plant is CIBA-GEIGY Plastics and Additives Co., located on the River Cam, Duxford, United Kingdom. A balancing lagoon with 3-4 days retention allows precipitation of resin sludge before pumping the effluent to the primary activated sludge plant aeration tank. This is operated at high mixed liquor suspended solids concentrations (12,500 mg per liter) with a sludge age of 50 days. The large sludge volume protects the plant from shock loads. The sludge survived a formaldehyde leak, which produced 4000 mg per liter formaldehyde levels in the effluent. However, a complete loss of sludge occurred after caustic soda solution leak raised the pH to 11 at a time when acid was not available for correction. A secondary activated sludge plant, biological filters, and an outfall ditch complete the system. Average wastewater contains (in mg per liter): BOD 1498; formaldehyde 332; and phenol 123. Treated effluent diluted with waste cooling water contains (in mg per liter): BOD 3.7; formaldehyde 0.71; and phenol 0.1. A centrifugation system for sludge disposal proved unsatisfactory. Currently, sludge aged 3-4 months is being applied to local farm land. (Cassar-FRC)
W82-03835

IMPROVED OPERATION OF MUNICIPAL WASTEWATER TREATMENT PLANTS IN SWEDEN BY USE OF INSTRUMENTATION AND AUTOMATION,
Swedish Water and Waste Water Works Association, Stockholm.
H. Holmstrom, and B. Hultman.
Water Science and Technology, Vol 13, No 8, p 7-13, 1981. 1 Tab, 8 Ref.

Descriptors: *Automation, *Measuring instruments, *Wastewater treatment, *Process control, Computers, Flowmeters, Maintenance, Control systems, Evaluation, Wastewater management, Wastewater analysis.

Some instruments and automated processes have substantially lowered the operating costs and increased process reliability at municipal wastewater treatment plants. The current status of continuously operating measuring equipment in Sweden was studied at 30 selected municipal wastewater treatment facilities. A total of 866 pieces of equipment were evaluated, representing three general categories of level detectors, flow meters for closed conduits and automatic analysis instruments. Results showed that instruments for the measurement of level, flow, dissolved oxygen, pH, suspended solids and COD were generally reliable. Some improvements are called for with regard to maintenance and use for certain difficult waters and sludges. Successful control of process units in whole or in part was reported for several applications. Progress was also evident in the regulation of the alkalinity of the effluent from the activated sludge process by the air supply to the aeration basin. The applications of computer control in wastewater are still somewhat limited. Great interest has been shown in the use of a central computer for the control of water and wastewater installations at different geographic locations. (Geiger-FRC)
W82-03846

TOTAL SLUDGE QUANTITY CONTROL FOR ACTIVATED SLUDGE PROCESS,
Hitachi Research Lab. (Japan).
M. Tanuma, M. Kashiwagi, N. Tuchiya, and T. Kasai.
Water Science and Technology, Vol 13, No 10, p 427-432, 1981. 6 Fig, 1 Tab, 1 Ref.

Descriptors: *Computers, *Process control, *Wastewater treatment, *Activated sludge, *Simulation analyses, Automation, Control systems, Sludge, Wastewater management, Mathematical studies, Mathematical models, Model studies, Biological wastewater treatment.

Experiences with computerized process control for wastewater treatment indicate that the sludge quantity is important for the stable operation of an activated sludge process. Sludge control was examined first by a two-control system involving sludge age control and a feedback control of sludge quantity. The two control systems were compared with regard to dynamic and static characteristics using block diagrams and transfer functions. The feedback control system proved more responsive and faster than the sludge age control system with respect to control performance. In a second investigation, a total sludge quantity control system was developed using the new feedback control method. This technique was shown to offer steady control for MLSS responses, total sludge quantity, wasted sludge flow rate and continuous and intermittent sludge withdrawal upon simulation analyses. The total sludge quantity control scheme was also superior to sludge age control for the control of activated sludge processes during wastewater treatment. (Geiger-FRC)
W82-03847

'IN-SITU' OPERATIONAL EXPERIENCES OF COMPUTER CONTROL IN WASTEWATER TREATMENT,
Custom Engineering Inc., Englewood, CO.
B. B. Mishra.
Water Science and Technology, Vol 13, No 10, p 509-516, 1981. 3 Fig, 4 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Process control, *Digital computers, *Cost analysis, Wastewater management, Wastewater facilities, Computers, Analog computers, Operating costs, Activated sludge, Aeration, *Activated sludge process, *Denver, Colorado.

Digital control applications in the field of wastewater treatment are still oriented mostly towards data logging and processing. Analog systems dominate the implementation mode of the automated control strategies utilized in process control. Some computer applications for wastewater treatment have tried with limited success. Little information exists in the literature about the operation of in-situ on-line digital wastewater treatment process control. The successful use of digital closed loop computer control is described for a high purity activated sludge treatment process used at the Metropolitan Denver Sewage Disposal District No 1. The success of this computerized system was attributed largely to an early commitment to the process and to effective management, especially in the areas of staffing levels and responsibility for supporting the control system. The benefits of the computerized system were seen in improved and reliable process control performance, decreased costs for treatment, and better facility management. (Geiger-FRC)
W82-03848

EXPERIENCES OF MLSS CONTROL OF THE ACTIVATED SLUDGE PROCESS,
Hitachi Research Lab. (Japan).
S. Nogita, S. Watanabe, and S. Mori.
Water Science and Technology, Vol 13, No 10, p 421-426, 1981. 9 Fig, 2 Tab.

Descriptors: *Process control, *Biological wastewater treatment, *Activated sludge, *Mixed liquor solids, Pilot plants, Sludge volume index, Wastewater treatment, Aeration, Control systems, Sludge, Organic loading, Chemical oxygen demand, Clarifiers, *Activated sludge process.

A Dynamic Sludge Reserving (DSR) process designed to hold activated sludge in the front end of an aeration tank provides an unlimited amount of sludge for determining the mixed liquor suspended solids (MLSS) level in an aeration tank. The DSR process was evaluated for three weeks in pilot plant tests. The pilot plant used a step-feed process for reference and the DSR process with a MLSS controller. Synthetic sewage was supplied to each process, and COD, MLSS levels in the second aeration tank were measured daily. The SVI of the DSR process was lower than that of the reference process due to the presence of less filamentous bacteria in the DSR process. The effluent COD of the DSR process remained low throughout the experimental period, while that of the reference process increased from the eleventh day of the experiment, due to sludge overflow to the effluent which caused increased organic loading. (Geiger-FRC)
W82-03849

THE DEVELOPMENT OF THE DESIGN PHILOSOPHY FOR THE AUTOMATION OF HOGSMILL VALLEY SEWAGE TREATMENT WORKS,
Thames Water Authority, London (England).
D. C. Allen, and D. W. Matthews.
Water Science and Technology, Vol 13, No 10, p 501-508, 1981. 1 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Computers, *Design criteria, *Computer programs, Wastewater management, Digital computers, Process control, Control systems, Automation, Wastewater facilities, *Hogsmill Valley Sewage Treatment Works, *United Kingdom.

The design philosophy for the automation of the Hogsmill Valley Sewage Treatment Works as set forth by a multi-disciplinary 'requirements group' is described. The design criteria called for a central computer with the usual peripherals, outstations connected to the central system by a digital network, and local control stations connected to the outstations. The system should also incorporate flexibility, distributed control, standby facilities at the control center and a balance between the local and central control systems. Reasons behind the choice of in-house software writing, the use of packaged process control software and real time high level language are discussed. The present design philosophy may not be applicable to other facilities but presents a suitable approach for a sewage disposal Authority with limited experience of continuous control, no experience of computerized control, and limited personnel. (Geiger-FRC)
W82-03850

OPTIMAL CODING OF ENERGY CONSUMPTION ON A SEWAGE PLANT AT HEIDELSHEIM,
Ingenieurgesellschaft m.b.H., Pforzheim (Germany, F.R.).
H. Lang, and W. Weber.
Water Science and Technology, Vol 13, No 10, p 489-494, 1981. 1 Fig.

Descriptors: *Computers, *Operating costs, *Process control, Biological wastewater treatment, *Wastewater treatment, Automation, Mathematical studies, Monitoring, Model studies, Computer models, Electric power costs, Costs, Energy, *Heidelsheim Sewage Plant, West Germany.

Results of an investigation of software efficiency for the optimal coding of energy consumption at the Heidelsheim Sewage Plant, West Germany are given. Sufficient load approximations were obtainable to prevent an oxygen deficit. The software coding for the gas engines has recently been improved. A mathematical relationship was drawn up to describe the correlation between the demand for current at Heidelsheim and the amount of rainfall. The demand for current is at a maximum during continuous rain. Recommendations for future research include the determination of a relevant parameter and the development of a practical continuous measurement method for the coding of biological sewage plants. The use of computers as model builders for coding, as storage units, and as monitors of total solids and o.ganic solids should also be developed. (Geiger-FRC)
W82-03851

PRACTICE AND PERSPECTIVE ON COMPUTER CONTROL IN SEWAGE PROCESS,
Fuji Electric Co., Ltd., Tokyo (Japan).
Y. Itoh, K. Ohkura, T. Shimizu, and M. Aoki.
Water Science and Technology, Vol 13, No 10, p 459-464, 1981. 6 Fig, 3 Ref.

Descriptors: *Computer models, Mathematical models, *Process control, Flow control, *Wastewater management, *Activated sludge, Water quality control, Wastewater treatment, Flow pattern, Model studies, Simulation analysis, Mixed liquor solids, Biological oxygen demand, Dissolved oxygen, Computers, Storm runoff.

Predictive control of sewage inflow in wastewater treatment plants allows energy savings on pump operation, reduction in operating time required of other units, more effective treatment, prevention of flooding, and reductions in pollution load caused by storm runoff. A physical model to predict storm water inflow is presented which may be integrated by computer with sanitary sewage flow patterns to predict inflow patterns to a wastewater treatment plant. Together these models may be used to design an optimum operation plan which may have a noticeable effect on process control. A mathematical model was also introduced into the computer system, which allowed the dynamic and static analysis of process operations under steady-state conditions. Results of MLSS behavior calculated by the dynamic analysis and DO and dissolved BOD calculated by the static analysis agreed satisfactiorily with actual process conditions. These simulation models are also useful in management decisions regarding the desired amount of energy savings through MLSS control and the resulting effluent quality. (Geiger-FRC)
W82-03852

A NEW MIXED LIQUOR SUSPENDED SOLIDS METHOD OF CONTROL WITH TOTAL SLUDGE MANAGEMENT,
Mitsubishi Electric Corp., Hyogo (Japan).
K. Maeda, M. Maida, S. Osada, T. Kuwata, and I. Nakahori.
Water Science and Technology, Vol 13, No 10, p 465-470, 1981. 8 Fig, 3 Tab, 5 Ref.

Descriptors: *Mixed liquor solids, *Biological wastewater treatment, *Process control, *Wastewater management, *Mathematical models, *Activated sludge, Aeration, Suspended solids, Model studies, Mathematical studies, Wastewater treatment, Water quality control, Theoretical analysis, Automation.

A new mixed liquor suspended solids (MLSS) control was developed which combines proportional return flow rate control and MLSS feedback control and utilizes waste sludge management to obtain the desired values of MLSS. The aeration basin biomass is kept at a constant concentration by the feed-forward and feed-back control strategy. Results of field tests showed that the present method affords better stability of MLSS and food/microbial mass than conventional control systems. The new MLSS control does not affect microbial properties and effluent quality; however, total sludge management is required to control MLSS over long periods of time. Further research is recommended on the prediction and control of sludge volume, the improvement of effluent quality during use of the MLSS control, and the estimation of the air flow and waste sludge volumes produced under automation. (Geiger-FRC)
W82-03853

A METHOD FOR THE EVALUATION OF THE EFFECTIVENESS OF A QUALITY CONTROL OPERATION IN ACTIVATED SLUDGE PROCESS,
Mitsubishi Electric Corp., Hyogo (Japan).
M. Maeda, J. Hirotsuji, K. Maeda, and S. Osada.
Water Science and Technology, Vol 13, No 10, p 471-476, 1981. 7 Fig, 4 Tab, 4 Ref.

Descriptors: *Mixed liquor solids, *Biological wastewater treatment, *Process control, Biological oxygen demand, *Aeration, Wastewater treatment, Wastewater management, Suspended solids, Activated sludge, Turbidity, Water quality control, Evaluation, Flocculation, *Activated sludge process.

A new mixed liquor suspended solids (MLSS) control technique designed for water quality maintenance in an activated sludge process was evaluated for effectiveness. Two identical sets of full scale plants consisting of three aeration tanks and six final clarifiers were operated simultaneously using the same influent but one with and one without the MLSS control. Results illustrated the stabilization of biological oxygen demand-suspended solids (BOD-SS) loading brought about by the MLSS control. Suspended BOD should be evaluated in relation to turbidity or suspended solids, since it depends upon the aeration and final clarification steps. Ocassionally, improvement of the effluent BOD due to MLSS control was not observed because of suspended BOD arising from microflocs in the effluent. It was recommended that the effectiveness of the control technique be evaluated from the viewpoint of total maintainability of the process, which would include such parameters as the properties and excess volume of the sludge and the aeration demand. (Geiger-FRC)
W82-03854

AN APPROACH TO FULL-AUTOMATIC CONTROL OF ACTIVATED SLUDGE PROCESS,
Toshiva Machine Co., Tokyo (Japan). Industrial Apparatus Engineering Dept.
R. Miura.
Water Science and Technology, Vol 13, No 10, p 451-457, 1981. 9 Fig, 3 Tab.

Descriptors: Biological oxygen demand, *Mathematical models, Computer models, *Automation, *Biological wastewater treatment, Oxygen uptake, Wastewater treatment, Wastewater management, Simulation analysis, Aeration, Dissolved oxygen, Mixed liquor solids, Process control, Sludge, *Activated sludge process.

In an effort to fully automate the activated sludge processes of a municipal wastewater treatment plant, measurements were made every two hours of biological oxygen demand (BOD), mixed liquor suspended solids (MLSS), oxygen uptake rate, and dissolved oxygen (DO). Hydraulic data were studied to interpret the physical behavior of sludge and its biological reaction in aeration and settling tanks. Rate processes were mathematically modeled to a computer program and simulations were carried out to evaluate an automatic control scheme for sludge flow management. An oxygen uptake scheme was also devised for biological sludge management. Sludge retention time (SRT) control of the feedback algorithm satisfactorily regulated sludge flow in situ, except during storm periods. Kinetics of oxygen uptake were explained by such parameters as MLSS, rate of substrate absorption, residual substrate levels and cell growth rate. (Geiger-FRC)
W82-03855

CALCULATION OF SLUDGE RESERVOIR VOLUME FOR MLSS CONTROL,
Hitachi Research Lab. (Japan).
S. Nogita, and M. Hiraoka.
Water Science and Technology, Vol 13, No 10, p 433-438, 1981. 5 Fig, 1 Tab, 1 Ref.

Descriptors: *Wastewater treatment, *Mixed liquor solids, Process control, *Mathematical models, *Sludge excess, *Aeration, Wastewater management, Mathematical studies, Model studies, Mathematical equations, Sludge, Biological wastewater treatment, Sludge volume index, Clarifiers.

To maintain a proper flow of return sludge and keep the mixed liquor suspended solids (MLSS) level constant, mathematical models and a technique for analytically determining the volume of a sludge reservoir were proposed. In the MLSS control system, the sludge reservoir is placed in the return sludge line. Return sludge may be temporarily stored in the reservoir and then pumped to the aeration tank when necessary. In the dynamic model to determine sludge concentration in an activated sludge process, a plug-flow-type aeration is assumed for simplicity. A mathematical assumption is devised to relate equations of the material balance of sludge in the front end of the aeration tank to the clarifier model proposed by Nogita and coworkers. By simplifying a block diagram for MLSS levels in an aeration tank, it can be reasoned that MLSS is influenced by sewage inflow rate. If reserved sludge is used to compensate for variations in the MLSS, the MLSS level can be kept constant. Mathematical expressions for calculating the required sludge reservoir volumes needed to stabilize a MLSS of 1.5 kilograms/cu m at a sewage inflow of 9,000 cu m/hour are given. In the case where the surplus activated sludge is 23,300 kilograms, the sludge reservoir should be 2,880 cu m or 7.2% of the aeration tank volume. (Geiger-FRC)
W82-03856

REQUIREMENTS AND APPLICATION OF CONTROL AND AUTOMATION SYSTEMS IN WASTEWATER TREATMENT- A CRITICAL VIEW,
National Water Council, London (England).
S. F. White.
Water Science and Technology, Vol 13, No 8, p 41-48, 1981.

Descriptors: *Wastewater management, *Control systems, *Automation, *Sensors, Wastewater treatment, Monitoring, Wastewater facilities, Data transmission, Research priorities, Design criteria.

All instrumentation, control systems and automation (ICA) equipment at a wastewater treatment plant should be considered an integral part of the treatment works. All expenditures for ICA, as with other civil engineering works, must be fully justified. Some priority areas for research and development in the treatment of wastewater are the production of reliable suspended solids sensors to allow optimum sludge draw-off and activated sludge treatment, and the formulation of more efficient means of measuring sewage flow. Other areas to be improved are the mechanization of screening, grit removal and sludge handling and treatment. The reliability of data transmission at low rates must also be increased. Wastewater treatment plants should be simple, reliable and easy to maintain. The consequences of plant breakdown must be taken into account and allowed for in the design. (Geiger-FRC)
W82-03858

ROLE OF SENSORS IN TRUNK SEWERS IN THE CONTROL OF FLOW AND WASTEWATER QUALITY,
Hitachi Ltd., Kawasaki (Japan). Systems Development Lab.
M. Shioya, S. Masui, S. Schimauchi, H. Ogasawara, and T. Ohto.
Water Science and Technology, Vol 13, No 8, p 55-60, 1981. 7 Fig, 1 Tab, 3 Ref.

Descriptors: *Sensors, *Sewer systems, *Monitoring, Water quality control, *Wastewater dilution, Sewers, Sewer hydraulics, Wastewater treatment, Mixing, Control systems, Water quality management, *Wastewater management.

A sensor allocation technique for monitoring and controlling water quality and quantity and a mixing and dilution method for controlling and reducing wastewater treatment plant loads are proposed for use in large sewer systems. The sensor allocation method is a two stage plan in which proper points are selected for each type of sensor and then the selected points are moved to determine which points are most commonly useful for the various objectives under consideration. This plan allows fewer sensors to be used. When highly concentrated sewage loads are detected in advance, the mixing and dilution control technique is applied. Diluent water may be stored at a pump station or a bypass trunk, and the mixing and dilution is performed either at the storage point or at a downstream confluence of two trunks. This method helps to prevent a decrease in discharge water quality due to greater sewage loads. These two proposed methods are recommended for use in future total sewer control systems. (Geiger-FRC)
W82-03859

INVESTIGATION ON CONSTANT F/M RATIO BY ADAPTION OF AERATION TANK VOLUME,
H. Hruschka, and W. Hegemann.
Water Science and Technology, Vol 13, No 10, p 495-499, 1981. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Aeration, *Activated sludge, *Cost analysis, *Biological wastewater treatment, Automation, Wastewater treatment, Sedimentation, Monitoring, Biological oxygen demand, Operating

costs, Organic compounds, Wastewater management, Process control, Activated sludge process, Wastewater facilities.

The processing of activated sludge accounts for a large portion of the expenses for operating a wastewater treatment facility. Automated load condition monitoring may help to decrease costs and energy demand. The optimal biological degradation of organic compounds progresses under steady-state conditions described by a constant f/m ratio. Adaptation of the f/m ratio of an activated sludge plant to the variations in inflow quality by the elimination of individual units of sedimentation and aeration tanks may reduce energy consumption. A standard load curve plus actual measured data of short-term BOD may describe the quality of the load. Activated sludge may be stored without aeration for about 8 hours without deterioration. The energy saving on the aeration step is about 30 to 40%. (Geiger-FRC)
W82-03860

STUDY OF NECESSARY FACTORS FOR ADAPTIVE CONTROL OF ACTIVATED SLUDGE SYSTEM,
Meidensha Electric Mfg., Co., Ltd., Tokyo (Japan).
E. Fujimoto, and T. Sekine.
Water Science and Technology, Vol 13, No 10, p 445-449, 1981. 2 Tab, 3 Ref.

Descriptors: *Activated sludge, *Wastewater management, *Process control, *Dissolved oxygen, *Nitrification, *Computer models, Wastewater treatment, Biological wastewater treatment, Electric power demand, Mathematical models, Simulation analysis, Model studies, Mathematical studies.

A new method for the optimal operation of activated sludge processes in time series is described. The technique, called adaptive control, attempts to select potential factors which may influence the system and isolate major factors from among these parameters based on their frequency response behavior or step response characteristics. Experimental dissolved oxygen (DO) and sludge age (SA) control were examined at a metropolitan sewage treatment facility. Results showed that for each control, the DO level is proportional to the nitrification rate. When the DO level is changed, the nitrification rate reaches the required level in one or two days. Changes in SA had no observable effect on the nitrification rate. Increases in the DO level or in SA caused an increase in electric power consumption by the blowers. Mathematical simulation models were used to verify the adequacy of experimental results. (Geiger-FRC)
W82-03861

SUPERVISORY COMPUTER CONTROL SYSTEM FOR ARAKAWA LEFT BASIN-WIDE SEWAGE TREATMENT PLANT,
Fuji Electric Co. Ltd., Tokyo.
M. Arai, M. Nakatsuji, Y. Itoh, and I. Matsunaga.
Water Science and Technology, Vol 13, No 10, p 477-482, 1981. 5 Fig, 1 Tab, 2 Ref.

Descriptors: Computers, Dissolved oxygen, *Wastewater management, *Process control, *Wastewater facilities, *Wastewater treatment, Computer models, Operating costs, Maintenance, Water quality management, Monitoring, Automation, *Arakawa Treatment Plant, *Japan.

The Arakawa Treatment Plant, opened in 1972, handles the sewage from 8 Japanese cities corresponding to a population of about 300,000. The facility presently treats about 355,000 cu m of sanitary sewage/day, with an increase expected to 1,383,000 cu m/day as the area's population increases to 1,817,800. The first computerized management system in Japan was introduced into the Arakawa Treatment Plant to control sewage treatment processes, collect and store data, and develop process models for the management of water quality. The Arakawa system also includes a plan for the autotuning of dissolved oxygen control, which will require minimal operator attention while allowing for accurate measuring during a very short (1 hour) time period. As energy savings become more important, future plant operations will be aimed at better management through computerized preventive maintenance and inventory control. (Geiger-FRC)
W82-03862

FATE OF PRIORITY POLLUTANTS IN LARGE MUNICIPAL TREATMENT PLANTS,
Metropolitan Sanitary District of Greater Chicago, IL.
For primary bibliographic entry see Field 5B.
W82-03867

KINETICS OF NITROGEN LOSS IN SIMULATED WASTEWATER TREATMENT IN A SOIL-PLANT SYSTEM,
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
R. A. Khalid, and W. H. Patrick Jr.
Soil Science, Vol 132, No 5, p 325-329, November, 1981. 1 Fig, 2 Tab, 21 Ref.

Descriptors: *Nitrogen removal, *Land disposal, *Wastewater treatment, Ammonia, Nitrates, Nitrification, Denitrification, Kinetics.

The objective of this study was to determine the loss of kinetics of nitrogen applied as ammonium and nitrate-nitrogen during an alternate aerobic-anaerobic cycle in an Olivier silt loam soil-ryegrass system such as occurs in overland flow treatment of wastewater. The Olivier silt loam soil used has a pH of 5.8 and a CEC of 6.2 meq/100 g soil, and contains 0.8% organic carbon. Loss of applied N-15 due to ammonia volatilization and denitrification processes was determined by subtracting the N-15 recovered in the soil and plant components from that applied to the soil-plant system. The kinetics of nitrogen loss in the treatments were computed using a linear, zero-order kinetics model. Substantial gaseous nitrogen losses of ammonium-nitrogen indicated the presence of favorable oxidation-reduction conditions for the simultaneous occurrence of nitrification-denitrification reactions. Gaseous loss through ammonia volatilization was not considered likely to occur due to the slightly acidic to neutral soil conditions. The rate of gaseous nitrogen loss computed by the model was 3.93 micrograms nitrogen per gram per day for the nitrate-nitrogen treatments and 2.09 micrograms nitrogen per gram per day for the ammonia-nitrogen treatments. Denitrification did not appear to be a limiting factor in the gaseous loss of applied nitrogen. The study indicates the importance of nitrification-denitrification processes in enhancing the efficiency of nitrogen removal during land application of municipal wastewater. (Baker-FRC)
W82-03869

MAXIMIZING EFFLUENT QUALITY FROM A MUNICIPAL ACTIVATED SLUDGE PLANT CONCURRENT WITH A MAJOR REDUCTION IN PROCESS ENERGY REQUIREMENTS,
Standard Oil Co., Chicago, IL.
J. F. Grutsch, D. C. Kloechner, and J. S. Moore.
AIChE Symposium Series, Vol 77, No 209, p 1-20, 1981. 18 Fig, 22 Ref.

Descriptors: *Activated sludge process, *Wastewater treatment, Effluents, Oil industry, Hydrocarbons, Ammonia, Organic compounds, Industrial wastes.

The performance of various activated sludge units was compared. Units compared were: high sludge age (SA) operation, conventional operation at 10 to 15 days SA enhanced with commercial powdered activated carbon (PAC), and high SA operation enhanced with ultrahigh surface area PAC. One train of the plant served as a control, and for experimental high SA operation the parallel train was modified with a granular media filter for prefiltering the influent to the activated sludge unit (ASU). When the performance of a conventional ASU operation at 6 to 12 days SA was compared to that of a high SA ASU operation at 17.4 degrees C, it was found that the high SA ASU nitrified completely; the effluent from the conventionally operated ASU had 50% more TOC and COD and 100% more total suspended solids than the high SA ASU; the clarity of the effluent from the high SA unit was spectacular; the high SA ASU generated about 20.9 kg/d TSS and the conventional unit 68 kg/d TSS; the high SA ASU generated 0.17 kg TSS/KG COD removed; and the chemical cost for prefiltration and primary clarifier optimization was 1.6/cubic meter. In all the individual tests, the 15 month program demonstrated the advantages of high SA and high SA enhanced with PAC, which represented suitable operating modes for achieving superb effluent quality in terms of minimal soluble organic carbon, chemical oxygen demand, total suspended solids, and ammonia nitrogen at unexpectedly low costs. (Baker-FRC)
W82-03874

A FINITE DIFFERENCING SCHEME FOR THE DYNAMIC SIMULATION OF CONTINUOUS SEDIMENTATION,
Wayne State University, Detroit, MI.
H. M. Anderson, and R. V. Edwards.
AIChE Symposium Series, Vol 77, No 209, p 227-238, 1981. 13 Fig, 28 Ref.

Descriptors: *Clarifiers, *Turbulent flow, Activated sludge process, *Model studies, *Wastewater treatment, *Sedimentation, *Detroit, Michigan.

This paper describes a model for simulation of continuous sedimentation in wastewater treatment. Unlike previous models, it accounts for turbulence around the feed zone of peripheral feed clarifiers. Studies at the Detroit Wastewater Treatment Plant indicated that the action of the feed creates agitation in the clarifier. This is responsible for the clarifier's inability to thicken the activated sludge and for a periodically poor effluent quality. The model was used to simulate a clarifier upset which occured at the Detroit plant on September 13-14, 1979. The operation was divided into three periods. In the initial 4 hours, flow through the clarifier was severely restricted and little turbulent mixing reached the thickening region. During the next 6 hours increased flow produced turbulent mixing in the thickening zone, forcing solids to overflow and severely degrade the effluent quality. During the third period flow to the clarifier decreased, solids concentration dropped, and effluent quality improved. A second shock wave occurred when the solids from the thickening region began to interact with the feed. (Cassar-FRC)
W82-03876

SIMPLIFIED MATHEMATICAL MODELS FOR A FLUIDIZED BED BIOFILM REACTOR,
Westvaco Corp., Covington, VA.
L. T. Mulcahy, W. K. Shieh, and E. J. Lamotta.
AIChE Symposium Series, Vol 77, No 209, p 273-285, 1981. 1 Tab, 13 Ref.

Descriptors: *Fluidized beds, *Biological wastewater treatment, *Wastewater treatment, Model studies, Mathematical models, Kinetics, Mass transfer.

A mathematical model is developed to aid in design and operation of fluidized bed biofilm reactors, which are used in wastewater treatment and biochemical manufacture. The model includes the following elements: (1) a biofilm model which gives the rate of substrate conversion by individual bioparticles, (2) a bed fluidization model which gives the biofilm thickness and number of bioparticles per unit of fluidized bed volume, and (3) an overall bed model which yields substrate concentration as a function of the axial position within the fluidized bed reactor. Models are given for both zero and first order intrinsic reaction kinetics. (Cassar-FRC)
W82-03877

PRECIPITATION OF HEAVY METALS WITH SODIUM SULFIDE: BENCH-SCALE AND FULL-SCALE EXPERIMENTAL RESULTS,
Kentucky Univ., Lexington. Dept. of Chemical Engineering.
D. Bhattacharyya, A. B. Jumawan, G. Sun, C. Sund-Hagelberg, and K. Schwitzgebel.
AIChE Symposium Series, Vol 77, No 209, p 31-38, 1981. 5 Fig, 6 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Heavy metals, Chemical reactions, Heavy metals, Sulfides, *Chemical precipitation, Hydrogen ion concentration.

An extensive investigation involving both laboratory scale and full scale sulfide precipitation behavior of heavy metals and arsenic was conducted. The feasibility of a combination of hydroxide-sulfide precipitation in a pH 8-9 process and a process involving sulfide precipitation at pH 3-5 followed by lime precipitation is established to achieve a high degree of separation of heavy metals and arsenic. The combination hydroxide-sulfide process required only 60% of the theoretical sodium slufide dosage to provide effective separations of heavy metals and arsenic. Simple sulfide precipitation at pH 3-4 also provided excellent removals for copper, cadmium, mercury, and lead. For precipitation of arsenic and zinc sulfide at pH less than 5, the side reaction between sulfite, if it is present in the wastewater, and sulfide must be considered. Hydrogen sulfide gas formation was not a problem in this study during precipitation due to the high reactivity of sulfides and heavy metals. (Baker-FRC)
W82-03878

WPCF PRESENTATIONS ATTUNED TO THE TIMES.
Water and Sewage Works, Vol 127, No 12, p 31, 32, 68, 69, December, 1980.

Descriptors: *Wastewater treatment, *Research, Aquatic plants, Primary wastewater treatment, Lagoons, Activated carbon, Disinfection, Control systems, Effluent standards, Incineration, Economic aspects.

Innovative and/or alternative techniques, realistic operating procedures, and energy conservation were the focus of papers presented at the Water Pollution Control Federation meeting in Las Vegas. Some innovative techniques reported were removal of pollutants from secondary effluent by vascular aquatic plants, sand filtration with air pulsing as a primay treatment of wastewater, a multicellular lagoon system, powdered active carbon in activated sludge processing, irradiation as an alternative to chlorine disinfection, and programmable control of wastewater treatment. Energy saving innovations included use of sludge incineratcr waste heat and careful control of air flow in multiple hearth furnaces. Operating costs can be saved by varying effluent standards according to receiving stream temperatures. (Cassar-FRC)
W82-03904

WASTEWATER TREATMENT FOR JAPAN'S RESEARCH INSTITUTE.
Water Services, Vol 84, No 1008, p S33-35, S37-39, Feburary, 1980. 5 Fig, 2 Tab.

Descriptors: *Chemical wastewater, *Research facilities, *Water reuse, *Wastewater treatment, Industrial wastewater, Desalination, Water treatment, *Japan, Reverse osmosis, Electrodialysis, Heavy metals, Activated carbon, Ion exchange, Chelation.

A laboratory wastewater treatment system for the Tsukuba Research and Academic City in Japan (43 research institutes and 220,000 population) was completed in May 1979. It uses some of the highest technology in pollution control. Wastewater from uncontaminated sources, such as river hydraulics research, is treated by sedimentation and sand filtration and used for miscellaneous purposes. Wastewaters containing cyanide, mercury, chromium, and heavy metal wastes are segregated and treated separately before entering the general wastewater treatment system. The general wastewater treatment system includes Cr(6+) reduction, sand filtration, pH adjustment, activated carbon adsorption, Hg-adsorbing chelating resins, final activated carbon adsorption, and heavy metals adsorbing chelating resin. Salt-containing wastewater is sand filtered and desalinated by reverse osmosis and electrodialysis. Other special systems treated organic wastes, cement-containing materials, and oily water. The sludge dewatering system is divided into physical (nontoxic) and chemical. The latter is dewatered and solidified with concrete to prevent leaching of heavy metals. The wastewater system is completely controlled by computer. It allows for water conservation and reuse. Currently 240,000 cu m of physical wastewater and 130,000 cu m of chemical wastewater is treated each year. (Cassar-FRC)
W82-03905

PALM OIL REFINERY WASTES TREATMENT,
Singapore Univ.
K. K. Chin, and K. K. Wong.
Water Research, Vol 15, No 9, p 1087-1092, September, 1981. 3 Fig, 5 Tab, 6 Ref.

Descriptors: *Oil wastes, *Flotation, *Palm oil wastes, Wastewater treatment, Industrial wastes, Activated sludge, Separation techniques.

Wastewaters from palm oil refineries are high in organics (up to 16,000 mg per liter BOD and 32,000 mg per liter COD) and oil and grease (up to 23,800 mg per liter) and are highly variable in concentration. Results of several treatment processes are compared. An inclined corrugated parallel plate oil separator with 25 mm spacing removed 91% of the oil and grease at a loading rate of 0.2 cu meters per sq meter per hr. Subsequent coagulation and flocculation reduced BOD to 450 mg per liter and COD from 8600 to 750 mg per liter after 30 min settling. Batch dissolved air flotation removed 90% of the suspended solids and produced an effluent quality similar to that from the inclined plate separator. Activated sludge treatment of the oil separator effluent, running at 0.3 g BOD per g mixed liquor volatile suspended solids per day, reduced the BOD level to 46 per liter and the COD to 380 mg per liter. Further treatment of the activated sludge effluent with alum, carbon adsorption, and sodium hypochlorite oxidation reduced the COD to 180 mg per liter. (Cassar-FRC)
W82-03909

AN INVESTIGATION OF BIOLOGICALLY ADJUSTED PH CHANGES IN DOMESTIC SEWAGE EFFLUENT,
New England Coll., Henniker, NH. Div. of Environmental Studies.
E. M. Saboski, C. Elliot, and K. Swanson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-198011, Price codes: A03 in paper copy, A01 in microfiche. Research Report No 36, September, 1981. 26 p, 5 Tab, 37 Ref. OWRT-A-057-NH(1), 14-34-0001-0131.

Descriptors: *Secondary wastewater treatment, *Hydrogen ion concentration, Aeration, Wastewater treatment, Protozoa, Bacteria, Comparison studies.

Small secondary treatment plants have reported a variety of pH problems in the past. One such problem has been an unacceptably low pH in a plant's discharge waters. To study the possibility of this problem being biologically induced, organisms in the aeration tank of a plant reporting low pH values were identified, counted compared to pH data from the plant's aeration tank and innoculated into sterilized wastewater. It was found that protozoans numerically dominated the eukaryotic organisms and bacteria the prokaryotic group. The most dominant protozoan, Zoothamnium sp., was found to have a + correlation with the pH values of the aeration tank. Three bacteria, Escherichia coli, Pseudomonas mallei and P. aeroginosa, lowered pH values of sterilized wastewater from a pH of 7 to as low a pH as 4.8 over a 96 hour test period. The greatest decrease in pH occurred over the first 36 hours of the test period.
W82-03953

TREATMENT OF PHENOL AND SUBSTITUTED PHENOLS WITH AN ANAEROBIC ACTIVATED CARBON FILTER,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
M. T. Suidan, W. H. Cross, K. A. Khan, and M. Fong.
Chemistry in Water Reuse, Vol 2, p 509-519, Ann Arbor Science Publishers, Ann Arbor, Mich., 1981. A-077-GA(4).

Descriptors: *Anaerobic filter, *Activated carbon, Aromatic, *Phenol, Catechol, o-Cresol, *Wastewater treatment, Water purification.

A wastewater treatment process consisting of a completely mixed-granular activated carbon packed-anaerobic filter was evaluated in the purification of synthetic solutions of phenol, catechol, and o-cresol. Excellent conversion of phenol and catechol was obtained with the production of stoichiometric quantities of methane gas. No measurable biological conversion of o-cresol was observed in the study leading to the conclusion that o-cresol was not degraded anaerobically when present as the only organic carbon source.
W82-03959

NPDES COMPLIANCE FLOW MEASUREMENT MANUAL,
Environmental Protection Agency, Washington, DC.
D. L. Guthrie.
MCD-77, September, 1981. 144 p, 46 Fig, 12 Tab, 29 Ref. 1 Append.

Descriptors: *Flow measurement, *Monitoring, *Effluent, Wastewater outfall, Wastewater pollution, Permits, Open-channel flow, Pipe flow, Gages, Pollution load, Water pollution control, *Regulations.

To comply with the permit requirements established under the National Pollutant Discharge Elimination System (NPDES), the wastewater discharger or permittee must determine the quantity of wastewater generated. Mass loadings are usually specified in NPDES permits, and flow data is critical to calculating pollutant loadings from unit concentration. Flows are measured in two ways: instantaneous and continuous. Instantaneous flows must be determined at the time samples are taken for analysis to calculate the pollutants discharged at a particular instant. In a continuous flow measurement system, the flows are totalled to obtain a value for total flow, used to verify NPDES compliance. There are four basic methods for determining flow: weighing the discharge, volumetric methods, sump pumps, and orifice buckets. Flumes, meters, and weirs are the kinds of devices normally employed to measure open channel flow. Other methods include: pitot tubes, head measurement, energy grade line calculations, orifices, nozzles, venturi flowmeters, open-pipe methods, open channel methods, stream gauging, dilution and tracers. Exotic methods sometimes used include: electromagnetic flowmeters, acoustic flowmeters, conductivity cells, hot-wire anemometers, and warm-film anemometers. (Moore-SRC)
W82-03965

ROTATING DISC BIOLOGICAL TREATMENT OF ACID MINE DRAINAGE,
Pennsylvania State Univ., University Park.
H. Olem, and R. F. Unz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-137219, Price codes: A07 in paper copy, A01 in microfiche. Environmental Protection Agency EPA-600/7-80-006, January, 1980. 131 p, 30 Fig, 22 Tab, 76 Ref, 5 Append. R805132.

Descriptors: *Acid mine drainage. *Biological wastewater treatment, *Iron, *Biological oxidation, Oxidation, Iron bacteria, Heterotrophic bacteria, Cost analysis, Water temperature, Hydrogen ion concentration.

Pilot scale (0.5-m diameter) and prototype (2.0-m diameter) rotating biological contactors (RBC) were investigated for oxidation of ferrous iron contained in six heterogeneous mine waters from coal mining sites in Pennsylvania and West Virginia. Continuous biological oxidation of Fe(II) to less

soluble Fe(III) was accomplished at natural mine water temperatures as low as 0.4 C and as high as 29 C. Reduction of Fe(II) oxidation efficiency at 0.4 C amounted to 10 to 20% of that achieved at 10 C at the same site. Microbiological oxidation with the 0.5-m RBC was unaffected at influent mine water pH values in the range of 2.18 to 5.50. Fe(II) oxidation efficiency was an average 10% lower with the 2.0-m than with the 0.5-m RBC under equivalent conditions with homologous mine drainage. The observed decrease in oxidation was due in large part to nonmicrobiological factors, such as increased short-circuiting, lower residence time, and a smaller effective surface area. Examination of solids samples removed from disc surfaces of the 0.5-m RBC operating at Hollywood, Pennsylvania revealed the presence of iron-oxidizing and heterotrophic bacteria in a gelatinous, iron-containing matrix. Costs for oxidation with the RBC were estimated to be about twice the amortized capital costs and one-half the operating costs compared to a conventional chemical oxidation process. Neutralization of RBC effluent and separation of precipitated iron solids must be applied in a complete treatment scheme to produce water of a suitable quality for stream-release. (Moore-SRC)
W82-03968

WASTE DISCHARGE MONITORING REQUIREMENTS UNDER THE NPDES PERMITS PROGRAM,
Systems Research Co., Philadelphia, PA.
S. R. Moore, and T. C. Covert.
Environmental Protection Agency EPA-600/S4-033, July, 1981. 5 p, 6 Tab, 3 Ref.

Descriptors: *Monitoring, *Effluents, *Permits, *Wastewater analysis, *Regulations, Water quality standards, Effluent limitations, Industrial wastewater, Wastewater treatment, National Pollutant Discharge Elimination System.

The Environmental Monitoring and Support Laboratory is responsible for developing a system for evaluating the equivalency of alternate analytical procedures proposed for use under the National Pollutant Discharge Elimination System (NPDES) Permits Program. The equivalency program for alternate test methods is based on comparability data obtained on representative samples from industrial categories most significant to the NPDES program. The Effluent Guidelines and Standards point source category subparts were examined to identify the appropriate Standard Industrial Classification (SIC) codes, and the analytical parameters for required testing for Best Practicable Technology 1977 and Best Available Technology 1983. A sample of 1051 actual NPDES permits from the ten Environmental Protection Agency Regions was analyzed to determine which parameters are to be monitored by each SIC industry. Based on these data, six tables were developed to provide information on the parameters most critical to the NPDES permits program, the type of discharge and the parameters to be monitored, and the number of discharges required to monitor specific parameters. A total of 233 parameters, including the 115 numbered parameters listed in Guidelines Establishing Test Procedures for the Analysis of Pollutants, were found in the sample of permits. As a result of this study, the Equivalency Program has a complete listing which provides information on the parameters most critical to the NPDES permits program. (Moore-SRC)
W82-03969

INNOVATIVE/ALTERNATIVE TECHNOLOGY PROGRAM; CASE STUDIES,
D. J. Hinrichs, N. E. Heim, J. A. Faisst, and B. E. Burris.
Environmental Protection Agency MCD-78, January, 1981. 46 p.

Descriptors: *Wastewater treatment, *Municipal wastewater, *Grants, Digestion, Biological wastewater treatment, Sewer systems, Recycling, Energy, Land disposal, Sludge disposal, Economic aspects, Technology program, Case studies, Clean Water Act.

Provisions within the Clean Water Act of 1977 are intended to encourage the advancement of technology and resource recovery by increasing grants for innovative and alternative wastewater treatment projects. Innovative projects consist of processes or systems which are new technology and include those in which nutrients or water are recycled, energy is recovered, or special sewer systems for small communities are provided. Alternative projects involve land treatment of wastewater or sludge. Case studies of eleven projects which have received additional grant funds through the program include a description of the project, the innovative or alternative components of the project, benefits and impacts of the Innovative/Alternative technology, and in some cases the procedure followed for obtaining grant funding. The innovative technology projects studied included: Kalamazoo, Michigan - powdered activated carbon with Zimpro reactivation; Burley, Idaho - microstrainers to remove algae from stabilization pond effluent; Lackawanna, New York - aerobic - anaerobic dual digestion system; Hillsborough, New Hamphire - application of rotating biological contactors and solar heated anaerobic digestion with methane gas recovery. Alternative technology projects included: Reedley, California - overloaded rapid infiltration modification; Manila, California - pressure sewers and community leachfield; and Cleveland, Mississippi - overland flow. Projects involving both innovative and alternative technology included: Jonesville/Jerusalem, Maryland - pressure sewers and land treatment; Austin, Texas - earthworm compositing, anaerobic digestion with energy recovery and water hyacinth ponds; Miranda, California small diameter gravity sewers and recirculating sand filters; and Bay Park, New York - fluidized bed secondary treatment, anaerobic digestion with gas recovery, and composting. (Moore-SRC)
W82-03970

WATER-QUALITY DATA FROM A LANDFILL-LEACHATE TREATMENT AND DISPOSAL SITE, PINELLAS COUNTY, FLORIDA, JANUARY 1979-AUGUST 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-03997

NITROGEN REMOVAL IN A SUBSURFACE DISPOSAL SYSTEM,
Dvirka and Bartilucci, Long Island, NY.
R. Forgione.
Clearwaters, Vol 10, No 1, p 13-15, March, 1980. 2 Fig, 1 Tab.

Descriptors: *Nitrogen removal, *Septic tanks, Denitrification, Design criteria, *Wastewater disposal, Leaching, Infiltration, Percolation, Leachates, *Suffolk County, New York.

A study was undertaken to develop an improved system for disposing of wastewater to reduce the leachate nitrogen reaching the groundwater in Suffolk County, Long Island, New York. The study encompassed the design, construction, and operation of a full-scale conventional septic tank-leaching field wastewater disposal system. The long range objective was the design of a nitrate-nitrogen removal system able to be built during new home construction. The key processes governing the transformation of nitrogen in the soil are nitrification and denitrification. As designed the system had three distinct treatment areas: the septic tank, to provide removal of settleable and floatable solids; unsaturated soil below the leaching field to provide aerobic conditions favoring nitrification; and a saturated zone in the impermeable pan to provide anoxic conditions favorable to denitrification. The spetic tank removed almost 20% of the influent ammonia and organic nitrogen. Nitrification of septic tank effluent ammonia occurred rapidly as the effluent leached through the soil, as evidenced by decreasing ammonia-nitrogen and increasing nitrate-nitrogen from various sampling points. Of the total nitrogen leaving the septic tank, a mass balance indicated that almost 40% was removed in the unsaturated zone. The study allowed the conclusion that nitrification of septic tank effluent occurred within 0.6 to 1.2 meters of vertical travel in a typical Long Island soil, and that denitrification could be achieved under controlled conditions in the ground under a conventional leaching field. (Baker-FRC)
W82-04001

AUTOMATION OF GRIMSBY PUMPING STATIONS,
Anglian Water Authority, Lincoln (England).
I. Ramsden.
Water Science and Technology, Vol 13, No 9, p 277-283, 1981. 1 Fig.

Descriptors: *Wastewater facilities, *Automation, Computers, Monitoring, Quality control, Pumping plants, Telemetry, Remote sensing, *Grimsby Pumping Stations, *England.

The telemetry and automation system of the new Grimsby Pumping Stations and Partial Treatment Works is described. The works serve two towns with a domestic population of 170,000 on the bank of the River Humber, split into three catchments. The fishing industry and associated food processing and supply industries govern the economy of the area. The automatic control and monitoring system was designed with the following information and objectives in mind: the system must be cost effective, with automatic sequence control operations requiring minimum manning. Reliable installation must be made with underground landline links. Future expansion must be possible using radiotelemetry to control and monitor outlying pumping stations and monitor other small stations. Data must be collected and stored with display on a working mimic on a V.D.U. (video display unit). The system must be able to be operated from a remote alternative control room. General principles of operation must include a master station to continuously interrogate the outstations, the ability to operate the system on the time division multiplex principle using digital techniques, a master station processor which can instigate appropriate signals to the outstation concerned when information is received that requires a change in plant operation, a master station to receive messages from the outstation and display them on the indicator panel and printer, a master station to control the alarm dialing equipment which is activated when the control room is not manned, a master station to receive information from rain gauge outstations, an arrangement so that data input changes are a simple operation, and a programmed automatic control system suitable for total control of the works and pumping station without operator interference. (Baker-FRC)
W82-04006

METHOD OF EVALUATING THE POSSIBLE ENERGY SAVINGS BY IMPLEMENTING DO-CONTROL OR FINE BUBBLE DIFFUSORS,
Vandkvalitetsinstitutet, Hoersholm (Denmark).
P. E. Sorensen.
Water Science and Technology, Vol 13, No 9, p 263-268, 1981. 3 Fig, 5 Ref.

Descriptors: *Wastewater facilities, *Cost analysis, Dissolved oxygen, Biochemical oxygen demand, Water treatment, *Wastewater treatment, Nitrification, Mathematical studies, *Activated sludge process.

A method is presented which makes it possible to estimate in advance the energy savings possible with the use of dissolved oxygen control or fine bubble diffusors in existing activated sludge plants. Possible savings vary from plant to plant, since they are dependent on the composition of the wastewater, the load and the operation of the plant. The method presented is based on measurement of the oxygenation capacity and efficiency of the installed aeration equipment over the entire range which can be controlled. For this purpose a method of measuring oxygenation capacity under conditions closely resembling operating conditions was developed. The method also considers measurement of biological oxygen demand removal and nitrification as a function of time, as well as measurement of the sludge concentration in the aeration tank. Measurement of the oxygenation capacity and effectivity, biological oxygen demand removal and nitrification allows a graph to be

drawn, from which the savings can be calculated. (Baker-FRC)
W82-04007

PRELIMINARY STUDIES ON CONTROL PARAMETERS AND BIOLOGICAL COMMUNITY FOR THE ACTIVATED SLUDGE PROCESS,
Meidensha Electric Co., Tokyo (Japan).
E. Fujimoto, and Y. Arai.
Water Science and Technology, Vol 13, No 9, p 189-192, 1981. 6 Fig, 4 Ref.

Descriptors: *Activated sludge process, *Biomass, *Wastewater treatment, Wastewater facilities, Water quality, Biological treatment, Dissolved oxygen, Sludge.

The relationship between a control parameter and the biological community in activated sludge was investigated at a sewage treatment plant. The study lasted for about 3 months. The influent volume in the plant was 50,000 cubic meters per day, the total aeration tank volume was 13,600 cubic meters, COD values of influent ranged from 50 to 80 mg/liter, MLSS ranged from 1,000 to 2,000 mg/liter and water temerature varied between 10 and 15 degrees C. The results indicated that the ammonia-nitrogen concentration was inversely related to the dissolved oxygen value in the aeration tank. As the ammonia-nitrogen concentration increased, so did the number of small flagellates. The rate of removal of phosphate was highest at a dissolved oxygen value of 3 mg/liter. As the number of amebas increased, the transparency was lowered. In the case of activated sludge type organisms the number of individuals tended to increase as the F/M ratio decreased. This was particularly true of Hypotrichida. The diversity index was noted to fall with a change in the sludge age (SA) setting value. From these findings it was concluded that the dissolved oxygen and SA value can be considered the restriction factors in terms of distribution and stability of the biological community. (Baker-FRC)
W82-04008

AN ALGORITHM ON OPTIMAL OPERATIONS OF ACTIVATED SLUDGE SYSTEMS,
Toshiva Corp., Tokyo (Japan). Heavy Apparatus Engineering Lab.
H. Kodate, R. Nakayama, and T. Shimizu.
Water Science and Technology, Vol 13, No 9, p 147-152, 1981. 8 Fig, 1 Tab, 2 Ref.

Descriptors: *Activated sludge process, *Algorithms, Mathematical studies, *Model studies, Simulation, Optimization, *Aeration tanks.

A newly developed algorithm is described which includes a compact method of prediction, a combined mathematical model of aeration tanks giving improved fit to the actual data, and a framing method for optimal operations of the system with a short execution time. An example of digital simulation results using actual data demonstrates the applicability of this algorithm for activated sludge systems. The major parts of the system studied are aeration tanks and settling basins. Influent wastewater enters the system through a combined sewer system. Adjustable elements in the system are both return sludge and waste sludge flows, which are decision variables over 24 hours. The operational objective is to keep daily variations of mixed liquor suspended solids (MLSS) in as small a range as possible. Other conditions include the number of adjusting times (to be arbitrarily specified), the time of adjustments (to be arbitrary), and the flows (to be continuous values under speed control of motor-driven sludge pumps or to be discrete values under set control). (Baker-FRC)
W82-04009

THE USE OF RESPIROGRAPHY IN BIOLOGICAL TREATMENT PLANT CONTROL,
Research Inst. for Water Resources Development, Budapest (Hungary).
P. A. Farkas.
Water Science and Technology, Vol 13, No 9, p 125-131, 1981. 2 Fig, 3 Ref.

Descriptors: *Wastewater treatment, *Quality control, *Microbiological studies, *Biological treatment, Wastewater facilities, Biological oxygen demand, Respiration, Automation, Measuring instruments, Activated sludge process.

A new measurement method for biological treatment plant control is described, i.e., respirography. The method is based on biological parameters, the substrate concentration of the waste and the maximum substrate removal rate of the sludge. An open reactor containing activated sludge aerated at a continuous rate is used. Samples of waste are added to the reactor. Concentrations of dissolved oxygen in the reactor are recorded as a function of the time. This record is called the respirogram, and it reflects respiration changes in the sludge. Peak areas on the respirogram due to waste addition yield substrate short term biological oxygen demand values. The times between up- and downswing of the peaks yield the times needed for the removal of added substrate. Removal rates can thus be calculated. A good reproducibility for the method was obtained, and an hourly measure of the short term biological oxygen demand or activity figure is also obtained which is sufficient for plant monitoring and control. Respirogram processing can be performed by a small computer attached to the output of the oxygen meter. The major applications of the measuring instrument are in the areas of monitoring of waste concentration, treatability, sludge adaptation, poisoning, loading and effluent quality, control of mineral nutrient dosage and sludge recirculation. (Baker-FRC)
W82-04011

THE EFFECT OF PARTICLE SUBSTRATE ON MINERALIZATION PERFORMANCE AND THE FORMATION OF EXCESS SLUDGE IN A COMPLETE MIXING AERATION TANK,
Kyoto Univ. (Japan). Dept. of Sanitary Engineering.
I. Somiya, and K. Kawamura.
Water Science and Technology, Vol 13, No 9, p 165-170, 1981. 8 Fig, 1 Tab, 1 Ref.

Descriptors: *Activated sludge process, *Mineralization, Sludge, Particle size, Chemical oxygen demand, *Model studies, Kinetics, *Wastewater treatment.

A kinetic model for substrate removal by activated sludge is developed. The model uses the DNA concentration in activated sludge as a parameter of active biomass. By applying this model to a complete mixing aeration tank, the operational factors such as chemical oxygen demand loading and withdrawal ratio of excess sludge are considered, taking into account the effect of substrate components in sewage and the influent DNA concentration. The influence of the particle substrate and the withdrawal ratio on the mineralization performance in a complete mixing aeration tank is theoretically analyzed. The increment of the particle substrate component and the decrement of the withdrawal ratio increase the mineralization performance. The effect of organic loading on the mineralization performance is determined more accurately by the chemical oxygen demand loading of DNA base and DNA age than those calculated by MLVSS. The withdrawal ratio is shown approximately as a function of such parameters as detention time, the mineralization performance and the substrate component. (Baker-FRC)
W82-04012

APPLICATION OF FLUIDIC DEVICES FOR CONTROL OF WASTEWATER TREATMENT OPERATIONS,
Cincinnati Univ., OH. Dept. of Civil Environmental Engineering.
H. C. Preul.
Water Science and Technology, Vol 13, No 9, p 139-146, 1981. 10 Fig, 1 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Quality control, Wastewater facilities, Water quality, Measuring instruments, *Fluid mechanics, Hydrodynamics. Fluidics technology, Control systems.

Concepts are presented for the application of fluidic devices in the control of wastewater treatment operations. Fluidics technology makes use of the hydrodynamic properties of fluids to eliminate or complement mechanical parts of equipment. Fluidics concepts are reviewed and a number of conceptual applications presented for the control of wastewater treatment operations. Fluidics principles arise from the basic fluid mechanics of a jet stream of common Newtonian fluids, including air, water and oils. The dynamic action of a fluid jet under varied boundary conditions can be used in fluidic devices to control various liquids transfer operations such as are found in the wastewater treatment field. Basic jet actions include laminar and turbulent jet flow cases, turbulent jet attachment to a boundary, and jet deflection and amplification. Wastewater treatment plants use instrumentation for basic measurements such as flow of liquids and gases and levels in tanks. These basic measurements provide information which is important to the treatment plant operator, such as treatment performance and proper flow distribution control, total plant flow for chemical dosage purposes, quality of effluent, cost of treatment and proper pacing of chemicals, and airflow to aeration tanks. Significant technical advantages in the use of fluidic control devices as compared with the more commonly used electrical or electronic control devices are that the fluidic devices have no moving parts, operation is simple and reliable under difficult conditions, and the cost is relatively low. (Baker-FRC)
W82-04013

AUTOMATIC MONITORING OF EXHAUST GAS ANALYSIS IN ACTIVATED SLUDGE WASTEWATER TREATMENT PROCESS,
Tokyo Inst. of Tech., (Japan).
H. Kubota, K. Fujie, and T. Kasakura.
Water Science and Technology, Vol 13, No 9, p 159-164, 1981. 7 Fig, 3 Ref.

Descriptors: *Activated sludge process, *Monitoring, *Wastewater treatment, Wastewater facilities, Quality control, Economic aspects, Oxygen demand, Biological oxygen demand, Aeration.

A new method is proposed for controlling the wastewater treatment process by constantly monitoring the composition of the exhaust gas from the aeration tank in an activated sludge process while observing the rate of biological uptake of oxygen in the tank directly and instantaneously. The empirical information needed for implementation has been acquired from experiments carried out under practical operating conditions of municipal wastewater plants. The major characteristics of the proposed monitoring method based on the exhaust gas analysis of the activated sludge aeration tank include the analysis of mole fractions of oxygen and carbon dioxide in exhaust gases with easy automation. This analysis can be performed with a stable high accuracy for long operating periods of the process. Instantaneous values of oxygen utilization in supplied air which is directly related to the aeration energy cost can be obtained. The requirement for oxygen in the aeration tank determined from oxygen utilization data is proportional to the biological oxygen demand removal rate in the tank. This allows prompt monitoring of the biochemical aspect of the process to be made quantitatively and automatically. Total BOD removed in the plant can be easily estimated without waiting for a 5 day BOD measurement. The automatic control of air feed rate to maintain the designated set-point of dissolved oxygen concentration in liquid is done with the help of the observed value of oxygen demand in the tank. The time decay in diffuser performance, caused by clogging of the diffuser, can also be quantitatively monitored. (Baker-FRC)
W82-04014

EVALUATION OF THE RESIDENT MASS OF SLUDGE IN FINAL SEDIMENTATION TANKS FOR WASTE SLUDGE CONTROL,
Meidensha Electric Co., Tokyo (Japan).
E. Fujimoto, and K. Goto.
Water Science and Technology, Vol 13, No 9, p 153-158, 1981. 5 Fig, 5 Ref.

Descriptors: *Activated sludge process, *Control systems, Automation, Sludge, Quality control,

*Wastewater treatment, Wastewater facilities, Aeration, Sedimentation, Suspended sediments, Sludge.

Information is offered about a new model for controlling the volume of activated sludge in the process of wastewater treatment. The model allows estimates to be made of both the volume of retention sludge and solid mass in the final sedimentation tank. Estimates are easily made on the basis of sludge settling characteristic curves which are obtainable from outputs of the settling comparisons between actual data and calculated results. In each stage of the process analysis was made on the basis of two factors: volume of settling sludge and volume of sludge taken out of the settling sludge and regarded as the return sludge and excess sludge. It is assumed in each stage that there is no suspended solid in the clarified water. In a process where the sludge goes on settling by the effect of gravity there are three types of layers: a layer which settles at a constant speed, a layer whose settling speed is decreasing in a transient state during compaction, and a compacted layer. This model is based on the assumption that there is no sludge concentration gradient due to the lowering of such layers, and the settling sludge is mixed uniformly. Even though the treatment plant studied has a rectangular sedimentation tank, good agreement was found between calculation and actual measurement. (Baker-FRC)
W82-04015

ULTIMATE BOD ESTIMATION IN RECEIVING WATER QUALITY MODELING,
Tufts Univ., Medford, MA.
J. J. McKeown, L. C. Brown, and C. H. Martone.
Water Science and Technology, Vol 13, No 10, p 353-370, 1981. 1 Fig, 4 Tab, 11 Ref.

Descriptors: *Biological oxygen demand, *Pulp wastes, *Model studies, *Wastewater management, *Wastewater oxidation, Wastewater treatment, Water quality management, Water quality control, Water quality, Water quality standards, Physicochemical treatment, Biological wastewater treatment, Kinetics, Nitrification.

Deoxygenation kinetics of papermill wastewater were investigated during a 200-day laboratory study. The experimental wastewaters used were subjected to biological and physical treatment regimes. Results showed that biologically treated papermill wastewater oxidized at a very slow rate for most of the BOD present in the sample. This rate was of an order of magnitude lower than that initially assumed in receiving water quality standards. A dual first order model best depicted the long term oxidation of the test samples. Conventional biological oxidation reduced fast-acting BOD but enhanced slow-acting BOD by the production of slow-oxidizing biological solids. Ammonia and nitrate measurements were adequate for the correction of NOD, while two NOD suppressants used also inhibited some portion of the carbonaceous oxygen demand. Trichloro-methylpyridine performed better than NH4Cl in inhibiting the NOD of a glucose-glutamic acid solution. In experiments using the dual first order model to estimate the ultimate BOD, the theoretical ultimate BOD of glucose-glutamic acid solution was reproduced to within plus or minus 9%. When the final nitrogen oxidation is assumed to go to nitrate, the reproduction is within plus or minus 4%. (Geiger-FRC)
W82-04016

DISSOLVED OXYGEN CONTROL IN THE ACTIVATED SLUDGE PROCESS,
Lund Inst. of Tech. (Sweden). Div. of Automatic Control.
G. Olsson, and J. F. Andrews.
Water Science and Technology, Vol 13, No 10, p 341-347, 1981. 8 Fig, 9 Ref.

Descriptors: *Process control, *Dissolved oxygen, Activated sludge, Graphical analysis, Computers, *Automation, *Wastewater treatment, Aeration, Graphical methods, Biological oxygen demand, Oxygen uptake, Oxygen demand, Mathematical studies, Hydraulic loading, *Activated sludge process.

In wastewater treatment activated sludge processes for both carbonaceous and BOD removal, variations in dissolved oxygen (DO) exist along the length of the reactor, which are known as the DO profile. The importance of an accurate DO profile has been previously recognized by operating engineers as a key tool for process control in wastewater treatment. The DO profile has been accurately described by models which have proved valid in full scale plant use. Computer-based graphical displays of the DO profile provide operators with means of reducing energy consumption while maintaining high levels of BOD removal. While total oxygen uptake rate can be estimated from a single DO measurement, one DO value may be inadequate for good process control. Measurement of DO at more points will permit the estimation of the nitrogenous oxygen uptake rate and provide significant improvements in process control. (Geiger-FRC)
W82-04017

A NEW INDICATOR OF THE ACTIVATED SLUDGE PROCESS - NITROUS OXIDE,
Hitachi Research Lab. (Japan).
S. Nogita, Y. Saito, and T. Kuge.
Water Science and Technology, Vol 13, No 9, p 199-204, 1981. 9 Fig, 2 Tab, 1 Ref.

Descriptors: *Activated sludge process, *Water pollution control, *Nitrous oxide, Sludge gas, Sludge, *Wastewater treatment, Wastewater facilities.

The objective of this research was to develop a new way of controlling an activated sludge plant by gas-phase instead of liquid-phase measurement. Two types of apparatus were used in this research. One had a complete-mixing-type aeration tank and the other had a plug-flow-type aeration tank. The relation between air flow rates and the nitrous oxide concentration of effluent gas was such that the nitrous oxide concentration decreased as the air flow rate increased and, with the same air flow rate, the nitrous oxide concentration increased as the nitrogen load increased. Diurnal variation in sewage inflow is the largest disturbance in a municipal sewage treatment plant. It was determined that the amount of nitrous oxide, which is produced in an aeration tank, in exhaust gas is an important indicator of process performance. The results indicated that the amount of nitrous oxide that is generated in an aerobic aeration tank is quantitatively detectable with a highly sensitive infrared spectrometer. The nitrous oxide formation rate was proportional to the size of the nitrogen load when the size of the organic load was constant. The air flow rate has little influence on nitrous oxide formation. The nitrous oxide formation was proportional to the product of the chemical oxygen demand and the nitrate-nitrogen concentration in mixed liquor. Irregularities in activated sludge floc in an aeration tank may explain nitrous oxide formation in that nitrous oxide is produced in the inner core of floc, which stays in an anaerobic state even though the outer shell of the floc is in an aerobic state. (Baker-FRC)
W82-04018

DEVELOPMENT AND USE OF A CONTINUOUS TOC-MEASUREMENT DEVICE IN WASTEWATER PURIFICATION,
Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W82-04019

THE CONTINUOUS OXYGEN UPTAKE RATE MEASUREMENT AND ITS APPLICABILITY AS AN ACTIVATED SLUDGE CONTROL PARAMETER,
Hamburg Univ. (Germany, F.R.) Dept. of Environmental Science.
I. Sekoulov, and D. Heinrich.
Water Science and Technology, Vol 13, No 9, p 205-210, 1981. 5 Fig, 4 Ref.

Descriptors: *Activated sludge process, *Monitoring, *Wastewater treatment, Wastewater facilities, Measuring instruments, *Oxygen uptake, Oxygen, Water pollution control.

Automation of wastewater treatment is being considered as one way of meeting stringent effluent standards and low energy costs. This attempt is encouraged by the automation of processes of the chemical industry where its benefit has already been demonstrated. To develop an automated activated sludge process it is first necessary to find suitable control parameters. The oxygen uptake rate of the MLSS is very often proposed for this purpose. The effectiveness of the respiration rate as a biomass parameter and the theoretical base of its application is automatic control was considered. A new device was also developed for continuous measurement of the respiration rate in situ. It was determined that the respiration rate measurement of the MLSS was a useful parameter characterizing its activity. The automated device must allow continuous measurements to be made in situ. Short time between taking of the sample and the oxygen uptake determination is necessary. More experience and continuous respiration rate measurements are needed before their benefit can be recognized for treatment plants automation. The respiration rate can be used as control parameter for wasting of excess sludge, preventing of shock or toxic loadings, homogenizing of the biological oxygen demand loading, and controlling the nitrification/denitrification process. (Baker-FRC)
W82-04020

COMBINED EFFECTS OF BIOLOGICAL SOLIDS RETENTION TIME AND TEMPERATURE ON THE GROWTH PARAMETERS OF ACTIVATED SLUDGE,
H. Harada, and J. Matsumoto.
Water Science and Technology, Vol 13, No 9, p 171-176, 1981. 5 Fig, 5 Ref.

Descriptors: *Activatred sludge process, *Water pollution control, *Wastewater treatment, Water treatment facilities, Biomass, Bacteria, Retention time, Respiration, *Temperature effects.

The effects of operational and environmental conditions in the mixed culture as selective factors on the growth parameters of activated sludge were investigated. The continuous flow experimental apparatus used was a single-pass completely mixed reactor with a working volume of 6.0 liters. The effects of solids retention time (SRT) and acclimation temperature on the respiratory parameters of populations cultured at different SRTs and temperatures were investigated using the Warburg method at thirteen different substrate concentrations ranging from zero to 1750 mg COD/liter. It was noted that shorter biological SRTs and elevated temperature at which activated sludge was continuously grown caused enrichment of the predominant population, following a change in the overall respiratory activity of the culture. Populations enriched at shorter SRTs and higher temperatures had a ratio of protein to carbohydrate content in the cells, and vice versa. A reduction in SRT as well as a decrease in acclimation temperature caused a shift in the optimum temperature to lower levels. The dependence of the saturation constant on acclimation temperature varied significantly with SRT. The potential for ecological adjustment due to shifts in population was more responsible for the gradual changes with temperature than physiological adaptation at the cellular level. (Baker-FRC)
W82-04021

AUTOMATIC MEASUREMENT DEVICE OF THE RESPIRATION RATE AND EXPERIMENTAL INVESTIGATION ON THE CONSTANT DO CONTROL BY USING THE DEVICE FOR THE ACTIVATED SLUDGE PROCESS,
Meidensha Electric Mfg., Co., Tokyo (Japan).
E. Fujimoto, K. Iwahori, and N. Sato.
Water Science and Technology, Vol 13, No 9, p 193-198, 1981. 9 Fig, 9 Ref.

Descriptors: *Activated sludge process, *Respiration, Measuring instruments, *Wastewater treatment, Wastewater facilities, Water quality, Water pollution control, Oxygen demand, *Japan.

A measuring device was developed for determination of respiration rate and use for monitoring or

process control on treatment facilities. The analyzer makes it possible to measure the value of the respiration rate in accordance with standard methods for sewage examination in Japan. The analyzer generated an exact respiration rate output value for about one month, without any maintenance service being needed. The result of application in actual treatment facilities has shown that, if the device is operated continuously at the inlet of the aeration tank, respiration rate can be used as a control parameter in compliance with influent load variation. If the respiration rate analyzer is operated continuously in the center of an aeration tank, the result suggests that constant dissolved oxygen control is possible with an index of respiration rates. (Baker-FRC)
W82-04022

COMPUTERIZED DATA ACQUISITION AND DATA HANDLING IN SEWAGE TREATMENT PLANTS,
Passavant-Werke Michelbacher Huette, Aarbergen (Germany, F.R.).
H.- B. Kloppel.
Water Science and Technology, Vol 13, No 9, p 305-310, 1981. 1 Fig, 1 Tab.

Descriptors: *Wastewater treatment, *Automation, Maintenance, Computers, Water treatment facilities, *Germany, Monitoring, *Systems analysis, Data aquisition.

At present the automation of sewage treatment plants can only be partly achieved. This is due to the difficulty of obtaining reliable test data. In efforts to lower operating costs, it is necessary to provide operating personnel with suitable instruments which ease the operation of sewage treatment plants. A data handling system is described which acquires and stores all test data and provides documentation by means of a process control computer. In order to optimize the treatment process, the numerical expression of these conditions is determined and indicated to the operating personnel or transmitted directly to the control equipment provided locally. On the basis of problems which have occurred with computer systems installed in Germany at sewage treatment plants, some of which have been in operation since 1976, the malfunction rates for the most important components of the system have been determined. The findings demonstrate that about two malfunctions per year occur for the complete data handling system. Due to the extensive dust contamination occurring in sewage treatment plants, regular maintenance must be ensured to maintain the proper functioning of the computer system. The expense for this maintenance of about two hours per month was regarded as relatively low in this study. Suitable safety precautions must be taken to maintain the operation of the plant in the event of computer failure. Monitoring of important test data must be ongoing and must be performed by instrumentation independent of the computer. (Baker-FRC)
W82-04023

A CONTROL SYSTEM FOR SMALLER WASTEWATER TREATMENT PLANTS,
Kyoto Univ. (Japan). Dept. of Sanitary Engineering.
M. Hiraoka, and K. Tsumura.
Water Science and Technology, Vol 13, No 9, p 299-303, 1981. 9 Fig, 1 Tab, 3 Ref.

Descriptors: *Wastewater facilities, *Control systems, Computers, Nitrification, Activated sludge process, Sludge, Flow patterns, Quality control, Heijo plant, *Japan.

A control system is proposed for medium or small scale wastewater treatment plants. The applicability of this control system has been checked in a Heijo wastewater treatment plant, which is a 341 cubic meter per hour activated sludge facility. The design of the control system based on the experimental results is summarized. The computer control system consists of four parts: an inflow control part, an effluent quality control part, a sludge settling property control part and a nitrification control part. Efforts are now directed toward establishing the strategy of the control system in the Heijo Plant. The first step in control is to predict the variation of the inflow rate and to equalize the input within a range in which the biological process is controllable. Once the inflow rate of sewage is equalized, the controllability of the activated sludge process increases considerably and the linear model of the process is applicable in spite of the nonlinearity of the activated process. As the inflow rate is controlled at a constant rate, the linear model is applicable to express the dynamic behavior. The model fitting method using the cross-spectral density function cannot be applied to the activated sludge system, as this system is a feedback system and the noises are not white. Concerning the sludge settling property control system, it is not clear whether better effluent control results in a better sludge settling property. Thus it is necessary to monitor and control the sludge settling property. The nitrification control system must suppress nitrification to guarantee the stability of the parameters of the autoregressive model. (Baker-FRC)
W82-04024

COMPUTER CONTROL OF NITRIFYING AND DENITRIFYING ACTIVATED SLUDGE PROCESS,
Technical Univ. of Denmark, Lyngby.
M. K. Nielsen, O. Persson, and M. Kummel.
Water Science and Technology, Vol 13, No 9, p 285-291, 1981. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Activated sludge process, *Automation, *Wastewater treatment, Simulation, Model studies, Nitrification, Denitrification, Nitrates, Ammonia, Oxygen, Computers, *Nitrogen removal.

Results are presented from simulation and experimental verification of different control strategies applied on a nitrogen-removing full scale sewage plant. The plant is operated as an alternating contact process. The manipulated variables in the control strategies were the length of the phases in the alternating process and the oxygen set point. Measured values were the concentrations of oxygen, ammonia, and nitrate. Simulations were performed to evaluate alternative control strategies. The simulations allowed certain conclusions to be drawn. The single sludge alternating nitrogen removal process can be improved by controlling the phase distribution and oxygen set point, so that a plant receiving double load halves its outlet concentration of total nitrogen. The improvements are relatively great, but the values are so small that measurement errors are relatively large. The improvements might be a result of changes in the conditions in the aeration tanks, as the mathematical model assumes, but the improvements might also have been initiated by improved settling characteristics. The mathematical model applied is a valuable tool in evaluating control methods and adjustment of the control parameters. However, the model shows greater sensitivity to load changes and control action than the full scale plant, so the final evaluation of different control strategies must be carried out on the specific plant. (Baker-FRC)
W82-04025

AERATION CONTROL FOR REDUCING ENERGY CONSUMPTION IN SMALL ACTIVATED SLUDGE PLANTS,
Arkansas State Univ., State University. Dept. of Agricultural Engineering.
R. C. Clifft, and J. F. Andrews.
Water Science and Technology, Vol 13, No 10, p 371-379, 1981. 4 Fig, 8 Ref.

Descriptors: *Aeration, *Oxygen demand, Process control, *Computer models, *Dissolved oxygen, Wastewater treatment, Activated sludge, Computers, Model studies, Organic loading, Biological oxygen demand, Oxygen uptake, Biological wastewater treatment, Simulation analysis, *Activated sludge process.

Frequently the automated dissolved oxygen (DO) control of aeration in activated sludge plants is not feasible for smaller wastewater treatment facilities due to the lack of skilled personnel to manage these complex systems. A simple control strategy is described that reduced excessive aeration at a considerable energy savings without the use of on-line DO sensors. Computer simulations were made of a small facility to study the typical daily oxygen demand curve with air supply patterns for constant and for controlled aeration rates. When using a signal from either a stored program or influent flow measurements, on-off and continuous control methods afforded significant reductions in the total air requirements when compared to a constant aeration rate. When the usual time lag between influent organic load and oxygen demand was taken into account, maximum air reductions were obtained. (Geiger-FRC)
W82-04026

A NEW APPROACH TO COMPUTERIZED CONTROL SYSTEM FOR THE ACTIVATED SLUDGE PROCESS IN TRANSIENT STATES,
Kyoto Univ. (Japan). Dept. of Sanitary Engineering.
S. M. Sheffer, K. Tsumura, and M. Hiraoka.
Water Science and Technology, Vol 13, No 10, p 381-386, 1981. 4 Fig, 17 Ref.

Descriptors: *Simulation analysis, Activated sludge, *Computers, *Model studies, Simulation, Mathematical studies, Process control, Kinetics, Wastewater treatment, Statistical methods, Prediction, Biological wastewater treatment, *Activated sludge process.

Some dynamic characteristics of the activated sludge systems of wastewater treatment processes should be considered in selecting models for improvement of process control. A new approach to control systems for the activated sludge process in transient states is described which combines mechanistic models and statistical methods in parameter/model fitting while control strategies are applied. A simulation program was used to study a mechanistic model of the activated sludge biosystem. Predicted results of the simulations were strongly influenced by values of kinetic parameters. These parameters were also important in calculating the predicted dynamic behavior of the activated sludge system. Parameters determined by statistical analysis with least squares fitting were found to yield satisfactory values. Proper sensors were vital to the quality of parameter fitting. A self tuning, computerized control system for activated sludge facilities was proposed. A set of hierarchial models was provided from which one model could be selected according to process conditions. The selected model's parameters should be tuned on-line in accordance with input-output data to reflect the actual dynamic behavior of the system. (Geiger-FRC)
W82-04027

ORGANIC LOAD CONTROL OF THE ACTIVATED SLUDGE PROCESS BASED ON PREDICTED DAILY VARIATION OF INFLUENT LOAD,
Hitachi Ltd., Kawasaki (Japan). Systems Development Lab.
S. Masui, M. Shioya, T. Ohto, and S. Nogita.
Water Science and Technology, Vol 13, No 10, p 387-392, 1981. 8 Fig.

Descriptors: Process control, *Model studies, *Wastewater management, Automation, *Simulation analysis, *Organic loadings, Wastewater treatment, Aeration, Mixed liquor solids, Biochemical oxygen demand, Sludge, Simulation, Mathematical studies, Mathematical models, Prediction, *Activated sludge process.

A control method was devised for adjusting the total amount of in-process sludge to achieve a higher quality effluent at a lower operating cost for the activated sludge process. In-process sludge volume is adjusted based on predicted variations of daily influent load. The system consists of an off-line planning subsystem and an on-line direct control system to afford flexibility and stability in the system. The off-line planning system determines the respective amount of return sludge and excess sludge at each control timing, based on the process dynamics defined by an inner aeration simulator and an inner sedimentation tank simulator. Com-

puterized simulation tests verified the control efficiency afforded by applying the system to the stabilization of mixed liqor suspended solids (MLSS). Results indicate that MLSS can be controlled within a 5% deviation from the reference value at an operating cost lower than that of manual control. (Geiger-FRC)
W82-04028

SPECIFIC OXYGEN DEMAND AS AN OPERATING PARAMETER FOR ACTIVATED SLUDGE PROCESSES,
Iowa State Univ., Ames. Dept. of Civil Engineering.
J. C. Young.
Water Science and Technology, Vol 13, No 10, p 397-403, 1981. 3 Fig, 1 Tab, 7 Ref.

Descriptors: Volatile solids, Activated sludge, *Biochemical oxygen demand, *Oxygen demand, *Mathematical studies, Wastewater treatment, Solid wastes, Mathematical equations, Process control, *Microorganisms, Sludge digestion, Biodegradation, *Activated sludge process.

Previous investigators have established the need for considering inactive volatile solids production during the biological growth of microorganisms in activated sludge processes. The specific oxygen demand (SOD), which is related to the effluent soluble biochemical oxygen demand (BOD) and the solids retention time (SRT), provides a rapid measure of biological activity and may be utilized in the control of activated sludge processes. Distinguishing between the active and inactive solids allows a more complete evaluation of the oxygen uptake characteristics of an activated sludge. It was demonstrated that the specific oxygen demand in milligrams O2/hr/gram VSS is related nearly exclusively to factors of biological growth while being relatively independent of short-term variations in waste load. Specific oxygen demand may also be used in the determination of the portion of active mass in a mixed volatile solids sample by measurement of the endogenous decay rate. (Geiger-FRC)
W82-04029

O & M COSTS AND OPTIMAL CAPACITY EXPANSION,
California Univ., Richmond. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 6B.
W82-04042

PREDICTION OF RBC PERFORMANCE FOR NITRIFICATION,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
Y. C. Wu, E. D. Smith, and J. Gratz.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 635-652, August, 1981. 12 Fig, 4 Tab, 22 Ref.

Descriptors: *Biological wastewater treatment, *Nitrification, *Prediction, Secondary wastewater treatment, Mathematical models, Performance evaluation, *Rotating biological contactor.

The rotating biological contactor (RBC) system is a fixed-film wastewater treatment process which has many of the advantages of the trickling filter process along with the treatment efficiencies of the more advanced activated sludge system. The RBC system has a large number of important process operating parameters, including influent substrate concentration, surface hydraulic load, rotational disk speed, effective disk surface area, submerged disk depth, liquid retention time, wastewater temperature, and stage number. Mathematical models capable of predicting the RBC plant performance in terms of efficiency of nitrogen removal when operating conditions are known were investigated. The study results show that if the survival and growth of nitrifying bacteria in the RBC waste treatment system is independent of pH and alkalinity, the efficiency of ammonia nitrogen utilization can be effectively predicted by determination of influent ammonia nitrogen concentration, hydraulic loading, wastewater temperature, and stage number. Nitrification models are presented for both situations in which the RBC unit is operated to serve as a secondary biological waste treatment system and those in which the unit is used as a tertiary treatment system. The models yield good agreement between calculated results and observed data reported earlier by other researchers. (Carroll-FRC)
W82-04043

TEMPERATURE EFFECTS ON BIOSTABILIZATION OF LEACHATE,
Sigman Resources Consultants Ltd., Vancouver (British Columbia).
R. Zapf-Gilge, and D. S. Mavinic.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 653-663, August, 1981. 3 Fig, 5 Tab, 10 Ref.

Descriptors: *Temperature effects, *Leachates, *Biological treatment, *Landfills, Aerobic treatment, Groundwater pollution, Water pollution control.

Although aerobic biological treatment has been shown to effectively stabilize landfill leachates at room temperatures, the effectiveness of this method at temperatures which prevail in actual Canadian treatment situations has not been investigated. Results from this study showed that primary reactors, operated at organic loadings ranging from about 0.96 to 3.2 kilograms of chemical oxygen demand (COD) per cubic meter per day (within F/M ratios of 0.25 to 0.70), achieved removals better than 95 percent for COD and 99 percent for five-day biological oxygen demand for temperatures ranging from 9 C to 23 C. Although most metals were reduced in concentration by more than 90 percent, further polishing was required. The resultant effluent satisfied most local pollution control objectives. Comparison of the overall performance of the single- and dual-stage systems indicated that biological leachate stabilization was independent of reactor staging. The shock imposed by the intermittent feeding operation of a fill-and-draw system was thought to be the major cause of the poor mixed-liquor separation experienced. These results suggest that the most effective treatment for high-strength leachates occurring in Canadian environmental conditions is primary aerobic biostabilization followed by biological polishing. The primary unit should be operated near its organic loading capacity to help ensure that the effluent contains sufficient biodegradable material to sustain the polishing process. (Carroll-FRC)
W82-04044

USE OF AQUATIC MACROPHYTES FOR WASTEWATER TREATMENT,
Black and Veatch, Dallas, TX.
W. J. O'Brien.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 681-698, August, 1981. 3 Fig, 6 Tab, 38 Ref.

Descriptors: *Wastewater treatment, *Macrophytes, *Aquatic plants, Duckweed, Water hyacinth, Wastewater facilities, Design criteria, Biological wastewater treatment.

Aquatic macrophytes such as duckweed and water hyacinth can be used in the treatment of municipal and industrial wastewaters when facilities are designed to take advantage of the natural characteristics of these plants. This means of wastewater treatment is currently considered by the Environmental Protection Agency to fall within the scope of the innovative and alternative technology provisions of Public Law 95-217. Hyacinth systems currently provide an effective and relatively inexpensive alternative for upgrading conventional lagoons to meet secondary or advanced secondary treatment standards in subtropical climates. Although hyacinth ponds offer a viable means of upgrading the effluent from both facultative and anaerobic stabilization lagoons in warm climates, they are much less attractive in colder regions due to the need for facilities to protect the plants. Programs funded by Public Law 95-217 could be used for the additional development needed to define conditions under which water hyacinths can be effective as advanced waste treatment processes and to establish optimum harvesting strategies for the plants and improved methods for achieving phosphorus effluent standards. Hyacinths appear to have good potential application for the treatment of industrial wastes if the system includes satisfactory solids disposal facilities. Although duckweed has a relatively wide geographic distribution and is comparatively easy to harvest, there is at present little interest in the use of this plant for wastewater treatment. (Carroll-FRC)
W82-04046

START-UP AND OPERATING EXPERIENCE WITH COMPUTERIZED CONTROL SYSTEM IN A 1.3 CU M/S (30 MGD) WASTEWATER TREATMENT PLANT,
EMA, Inc., St. Paul, MN.
R. W. Graupmann, D. I. Knudsen, P. V. Manns, and T. P. McConville.
Water Science and Technology, Vol 13, No 10, p 405-411, 1981. 4 Fig.

Descriptors: *Wastewater treatment, *Automation, *Wastewater facilities, *Digital computers, *Process control, Activated sludge, Biological wastewater treatment, Computers, Expansion, Sludge drying, Sludge digestion, Sludge disposal, Design criteria, Monitoring, Maintenance, *Sioux City, Iowa.

As a result of new effluent standards, the Sioux City, Iowa municipal wastewater treatment plant had to upgrade and expand its existing primary treatment plant. The facility operates a 30 mgd activated sludge plant, serving a population of 100,000. Planners decided to adopt a central monitoring and control system using a digital computer. The Buell and Winter Engineers firm handled the design phase and bids for construction, and EMA, Incorporated was hired by the city to plan a new operation and maintenance system for the upgraded facility. The computerized operation of the plant was successfully handled by retraining existing staff. The new system has overcome many of the usual problems and now offers flexible control of most treatment activities. The results of the expansion have upgraded the Sioux City facility from a 0.7 cu m/s primary plant to a 1.3 cu m/s air activated sludge plant with centrifugal sludge dewatering, sludge digestion, and land disposal. (Geiger-FRC)
W82-04047

SOLIDS INVENTORY CONTROL IN THE ACTIVATED SLUDGE PROCESS,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
T. M. Keinath.
Water Science and Technology, Vol 13, No 10, p 413-419, 1981. 8 Fig, 2 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Sludge thickening, Activated sludge, *Clarification, *Graphical analysis, Aeration, Clarifiers, Biological wastewater treatment, Theoretical analysis, Porcess control, Mathematical studies, Graphical methods, *Activated sludge process.

Clarification and thickening overloads of secondary clarifiers may lead to the transfer of biosolids from the aeration basin to the clarifier. Two solids inventory control strategies were investigated that serve to eliminate thickening and clarification failure in the activated sludge process and minimize the net transfer of biosolids from the aeration basin to the clarifier, which may lead to the discharge of solids over the weirs of the clarifier. In situations in which thickening overloads exist, the recycle rate control method proved effective. In situations where clarifiers are overloaded with respect to both thickening and clarification, the step-feed control strategy is more applicable. These two strategies were described by a previously developed gemoetrical technique which served as the basis of a conceptual framework known as the 'state point concept'. This concept has been shown to be of significant use for the design and operation

evaluation of activated sludge processes in municipal wastewater treatment systems. (Geiger-FRC)
W82-04048

AUTOMATIC FLOW CONTROL IN COMBINED SEWER SYSTEMS-EFFECTIVENESS AND IMPLEMENTATION PROBLEMS,
C. H. M. Abraham, and H. W. Broeker.
Water Science and Technology, Vol 13, No 9, p 269-275, 1981. 4 Fig, 4 Ref.

Descriptors: *Wastewater facilities, *Automation, Computers, Wastewater treatment, *Hamburg, Germany, Municipal wastes, Monitoring, Water pollution control, Mathematical models, Costs, *Combined sewers, Interceptors, Maintenance, *Flow control.

Hamburg, Germany, is among the cities served by combined sewerage systems which have become inadequate to handle flows during storms. A plan was developed for economically upgrading this system to reduce overflow to receiving waters. A system of new interceptors is being installed to disconnect the sanitary flows discharged from the suburban area into the combined sewers. The main water pollution control plant will be expanded to a capacity of 17 cu m/sec. A master plan for the area was developed in the mid-nineteen seventies. It comprises construction of an additional 20 km of interceptors and 14 underground detention reservoirs and the reconstruction of a number of old trunk sewers, and will take at least 20 years to complete. An automatic flow control project has been initiated to optimize use of the city's facilities. A mathematical model was developed to simulate the potential benefits of various automated flow control strategies, including outfall structure control, detention basin control, in-system storage control, and interceptor entries control. Flow control was shown to be cost effective for Hamburg in a comparison with equivalent off-line storage costs. Implementation problems could arise with existing personnel unless they are carefully oriented to the new system. (Baker-FRC)
W82-04049

THE BASF TOXIMETER - A HELPFUL INSTRUMENT TO CONTROL AND MONITOR BIOLOGICAL WASTE WATER TREATMENT PLANTS,
BASF A. G., Ludwigshafen am Rheim (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W82-04050

OPTIMIZATION OF AUTOMATED EQUALIZATION BASIN-REACTOR SYSTEMS FOR CHEMICAL TREATMENT OF WASTEWATER,
Wayne State Univ., Detroit, MI.
B. M. Khudenko.
Water Science and Technology, Vol 13, No 10. p 355-362, 1981. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Automation, *Wastewater treatment, *Equalizing basins, *Graphical methods, Process control, Flow regulators, Mathematical equations, Mixing, Graphical analysis, Dynamics, Fluctuations, *Comparison studies.

Results of comparisons of equalization basins of variously designed wastewater treatment systems showed that multichannel equalization basins dampen regular as well as random fluctuations better than complete mix ranks or n-tanks in series. Multichannel equalization basins may be tuned to dampen oscillations in a given range of frequencies. An analysis was carried out of the propagation of regular and random signals through automated reactors. Results indicated that the stability and performance of the reactors was dependent upon the delay and inertia of the dosing channel, the retention time and intensity of reactor mixing, and the control law of the automatic control system. When the equalization basin is tuned for damping frequencies in the passage band of the reactor, optimal damping of incoming fluctuations can be attained by the system reactor-equalization basin. The volumes of the reactor and the equalization basin may be distributed to allow minimum total tank volumes for specific maximum fluctuations in output. (Geiger-FRC)
W82-04052

A COMPUTER-BASED STRATEGY FOR THE CONTROL OF EQUALIZATION TANKS,
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
P. L. Dold, H. O. Buhr, and G. v. R. Marais.
Water Science and Technology, Vol 13, No 10, p 349-354, 1981. 4 Fig, 2 Ref.

Descriptors: *Process control, Predictions, Computers, *Wastewater management, Mathematical studies, *Computer models, Wastewater facilities, Flow regulators, Wastewater treatment, Mathematical equations, Fluctuations, Automation, *Control systems, Equalization tanks.

For smaller wastewater treatment plants, the effects of both flow and load fluctuations can be minimized by the installation of an equalization or balancing tank upstream of the plant. A microprocessor-based control strategy for the operation of such an equalization tank is examined which is based on an equalization algorithm. The incorporation of the equalization algorithm for the real time operation of an equalization system involves the prediction, at any point in time, of the expected influent patterns for the ensuing 24-hour period. The prediction is based primarily on historical inflow and concentration data, but it incorporates differences between historical and actual inflow rates. Historical data are stored in a computer memory bank and updated as necessary. The implementation of the control strategy in the central minicomputer requires only the liquid level in the tank as input. The computer supplies a set point signal to an outflow control system, and monitoring of concentration on a continuous basis is not necessary. Plans are being made to apply the control strategy to a 33 mgd wastewater treatment plant at Johannesburg, South Africa. (Geiger-FRC)
W82-04053

MONITORING OF TURBIDITY AND SUSPENDED SOLIDS CONCENTRATION IN WASTEWATER TREATMENT PLANTS,
University of Strathclyde, Glasgow (Scotland). Dept. of Applied Physics.
J. M. Crowther, and S. Al-Ani.
Water Science and Technology, Vol 13, No 9, p 247-254, 1981. 6 Fig, 2 Tab, 6 Ref.

Descriptors: *Turbidity, *Measuring instruments, *Wastewater treatment, Monitoring, Water Quality, Water Treatment, *Suspended solids, Wastewater facilities.

The units and calibration standards are discussed for turbidity measurements, and a design is offered for an absorptiometer. Formazin standards were used to calibrate the instrument. Results for a typical activated sludge plant showed that turbidity was highly correlated with suspended solids concentration for incoming sewage and primary tank effluent, but only slightly correlated for final effluent. Many varied empirical definitions of turbidity have arisen, emphasizing different aspects of light scattering, due to vagueness in the definition of turbidity itself. Confusion in turbidity measurements also arises from the question of whether a mono- or polychromatic light source is employed. The third source of confusion has been the variety of methods employed for preparing reproducible standards. These three problems could be overcome if the formazin standard were taken as defining turbidity and the unit of measurement (FTU). The regression analyses made in these experiments showed interesting possibilities for predicting suspended solids from turbidity for both the incoming sewage and primary tank effluent. The measurement time for turbidity is much less than for the gravimetric method, and with a process instrument is practically instantaneous in most cases, thus allowing on-line estimates of suspended solids to be made. In principle the absorption turbidimeter could be adapted to measure higher turbidities, greater than 1000 FTU, by using a more intense source and lower turbidities, less than 40 FTU, by lengthening the optical path using a longer cuvette or special cell. The instrument can also be adapted for process control. (Baker-FRC)
W82-04054

PROBLEMS AND SOLUTIONS ON SLUDGE LEVEL MEASUREMENT,
Hitachi, (Japan).
M. Fukunaga, and K. Otajima.
Water Science and Technology, Vol 13, No 9, p 177-182, 1981. 5 Fig, 2 Tab, 3 Ref.

Descriptors: *Sludge solids, *Measuring instruments, *Control systems, Wastewater treatment, Density, *Automation, Sludge level measurement.

Three problems in using a sludge level gage in automatic control systems were investigated. Interferences from bubbles and solid matter were removed by refining the signals with a microprocessor. Zero drift caused by slime attaching to the density detector was corrected either by cleaning with an air jet or automatic zero calibration. Cleaning with an air jet for 1 min removed 96% of the slime, whereas water jets, ultrasonic waves, and electrolysis were less effective, 69-89% removal in 2 min. The automatic zero calibration was carried out by raising the instrument into the relatively clear supernatant liquid in combination with signal processing. Reliability of the moving contact part, easily corroded by chlorine and high temperature and humidity, was increased by using a capacitance type potentiometer of the non-contact type. The main unit and density detector were connected with a flexible cable. (Cassar-FRC)
W82-04055

MICROPROCESSOR ARCHITECTURE AND PERFORMANCE IN WASTEWATER PROCESS,
Florence Univ. (Italy). Inst. of Computer and System Science.
S. Marsili-Libelli.
Water Science and Technology, Vol 13, No 10, p 333-339, 1981. 4 Fig, 10 Ref.

Descriptors: *Computers, *Wastewater management, *Data transmission, *Activated sludge process, *Process control, Automation, Wastewater treatment, Data processing, Sedimentation, Biological wastewater treatment, Operating costs, Chlorination.

Results of a preliminary study of microprocess control of the activated sludge process in wastewater treatment are presented. Some advantages of decentralized design as opposed to centralized computing systems are reviewed. The function of the plant master processor and the local controllers for primary sedimentation, the biological reactor, the chlorination contact chamber, anaerobic digestion and power generation are discussed. Data are exchanged between subunits with the aim of providing increased reliability and reduced operating costs of process control and easier management by plant personnel. A serial data transfer protocol is outlined which provides an efficient data network with a minimum amount of computer hardware and is suitable to specific process needs. The overall structure of the microprocessor system is evaluated in relation to interprocessor data transfer. (Geiger-FRC)
W82-04056

AN APPROACH TO THE CONTROL OF THE ACTIVATED SLUDGE SYSTEM BY USE OF A SUCCESSION MODEL,
Kyoto Univ. (Japan). Dept. of Sanitary Engineering.
M. Hiraoka, and K. Tsumura.
Water Science and Technology, Vol 13, No 10, p 327-332, 1981. 5 Fig, 3 Tab, 2 Ref.

Descriptors: *Mathematical models, *Activated sludge, *Succession, Case studies, Wastewater treatment, Model studies, Mathematical studies, Analysis of variance, Graphical analysis, Ecosystem, *Biological wastewater treatment, Wastewater management, Water quality control.

A new approach to the control of the activated sludge system using an ecosystem succession model is described. The model was based on the analysis of variance for defining the variables which controlled succession and cluster analysis studies for defining the variables which controlled succession and cluster analysis studies for defining the stable parameters of succession in the activated sludge ecosystem. It was assumed that the state of the activated sludge fluctuates from one stable state to another due to changes in operating or environmental conditions. The purpose of the proposed model is to allow manipulation of the variables to either stay in one satisfactory stable state or transfer into another according to long term alterations in environmental conditions. The model was applied to two different wastewater treatment systems. In the first case study, cluster analysis was carried out on the basis of three variables: effluent BOD, MLSS, and the ratio of return sludge suspended solids (SS) to MLSS. In the second case study, analysis variables included temperature, pH, SS and total organic carbon (TOC) in the influent; turbidity, SS and TOC in the effluent; MLSS, MLVSS, air flow rate, DO and SV in the aeration tank; and SS and flow rate in the recycle line. The succession model for the first case study contained five clusters, while the second contained six clusters. (Geiger-FRC)
W82-04057

PREDICTION MODEL BY GROUPING METHOD OF DATA HANDLING (GMDH) FOR EFFLUENT QUALITY FROM SEWAGE TREATMENT PLANT - PREDICTION MODEL OF TRANSPARENCY OF EFFLUENT FOR AUTOMATIC CONTROL,
Neya River Basin-Wide Sewage Works Association (Japan).
M. Yamamura, H. Kitagishi, T. Yamashita, and S. Yamawaki.
Water Science and Technology, Vol 13, No 10, p 319-325, 1981. 7 Fig, 2 Tab, 7 Ref.

Descriptors: *Mathematical models, *Activated sludge, *Transparency, *Automation, *Prediction, Process control, Water quality control, Model studies, Wastewater treatment, Effluents, Wastewater management, Optical properties, Data interpretation, Data processing.

The grouping method of data handling (GMDH) was used to formulate a prediction model of effluent quality from a wastewater treatment plant. R-filter type GMDH was recognized as the most useful GMDH program to identify a mathematical model which can best handle changes in influent quality, aeration tank conditions or other parameters which affect the operation of the activated sludge process. This program was applied as a long-term prediction model using the transparency of the effluent (TRSe) at the Kawamata Sewage Treatment Plant of the Neya River Basin-Wide Sewage Works Association of Japan. The obtained mathematical model for predicting TRSe was used as an outputs equation of the sewage treatment system. When changes in the condition of the system occurred and large prediction errors resulted, a new appropriate mathematical model was identified by R-filter type GMDH. When insufficient data was available to select a new mathematical model, the former mathematical model was corrected by the method of least squares and then used as the new output equation for the system. (Geiger-FRC)
W82-04058

THEORETICAL CONSIDERATIONS FOR CONTROL AND MONITORING OF WASTEWATER TREATMENT SYSTEMS,
University of Strathclyde, Glasgow (Scotland). Dept. of Applied Physics.
J. M. Crowther.
Water Science and Technology, Vol 13, No 9, p 239-246, 1981. 3 Fig, 12 Ref.

Descriptors: *Wastewater treatment, *Monitoring, *Measuring instruments, Wastewater facilities, Sampling, Sensors.

The choice of sampling interval in monitoring wastewater treatment system effectiveness is considered. Other considerations are the method of sampling or measurement, the types of sensors used, and the characteristics of the system and variables being measured and controlled. The theory of data collection is developed with particular reference to wastewater treatment processes. It is determined that for a faithful record one should ideally use a sensor with adequately high frequency response to follow variations in the water quality variable. To avoid aliasing one should sample the sensor output at more than twice the frequency of the highest significant frequency component in the signal, and one should ensure that the full range of the analog to digital converter is covered in order to minimize digitization errors. For some purposes the ideal procedure generates too much data. For alarm purposes the sensors must usually be on-line continuously, and the most economical way of incorporating this in a computer controlled plant is through an interrupt procedure. (Baker-FRC)
W82-04060

CONTROL OF DISSOLVED OXYGEN IN ACTIVATED SLUDGE PLANTS,
Emschergenossenschaft, Essen and Niersverband, Viersen (Germany, F.R.).
S. Schlegel, and J. Lohmann.
Water Science and Technology, Vol 13, No 9, p 225-232, 1981. 6 Fig, 1 Tab, 5 Ref.

Descriptors: *Activated sludge processes, *Dissolved oxygen, *Monitoring, automation, Water pollution control, Wastewater facilities, Water treatment facilities, *Wastewater treatment, Dissolved oxygen control.

Results are presented from studies on the automation of treatment plants. In control systems it is important that the dissolved oxygen content can be measured accurately enough, that the measurement is taken at a point where an alteration in the oxygen demand can be detected early enough, and that the feed aggregates are so designed that oxygen input can follow an alteration in the oxygen demand. In order to investigate the suitability of various dissolved oxygen measuring devices up to 10 different devices were tested at several treatment plants between 1976 and 1978. Accuracy, dependability and ease of maintenance were all considered. Only a fraction of the devices fulfilled operational requirements with respect to design and equipment. The simple control circuit is used predominantly. Particularly in the case of completely mixed tanks, good control results are obtained. In the case of cascade-type or plug-flow aeration tanks, the average value is frequently established from the initial and final measurement. This does not consider the locally differing oxygen demand conditions. In order to better take into account the requirements for differing oxygen demand and oxygen content, cascade-type or plug-flow aeration tanks should be divided into several separately controlled tank sections. If more than two separate control circuits are needed, a control on the basis of auxiliary factors is sometimes installed. Preference should, in general, be given to non-interconnected arrangements. (Baker-FRC)
W82-04061

DISSOLVED OXYGEN CONTROL USING AERATION EXHAUST GAS,
Fuji Electric Corporate Research and Development Ltd., Kanagawa (Japan).
R. Tanuma, O. Shimizu, K. Takeda, and N. Tanji.
Water Science and Technology, Vol 13, No 9, p 183-188, 1981. 7 Fig, 6 Ref.

Descriptors: *Activated sludge process, *Dissolved oxygen, Water analysis, Oxygen, *Aeration, Water pollution control, *Wastewater treatment, Wastewater facilities, Dissolved oxygen control.

The dissolved oxygen content control in activated sludge processes is discussed. Control is achieved by oxygen content analysis of aeration exhaust gas. Monitoring of the dissolved oxygen content in the activated sludge process not only improves the effluent quality but also saves on electric power consumed for the aeration. The method of analysis is based on the relationship between the aeration air flow rate, the oxygen content difference between the exhaust gas and the atmosphere, and the dissolved oxygen in air saturated water. This method using gas analysis, is free from problems caused by contamination of the sensor. Dissolved oxygen control by this method was attempted at a full scale plant treating 50,000 cubic meters of sewage per day. The value of dissolved oxygen at the exit of the aeration tank was controlled at about 3.5 mg/liter for 24 hours except for overshooting in the first 8 hours. (Baker-FRC)
W82-04062

POST-SECONDARY TREATMENT OF EFFLUENT FOR DRIP IRRIGATION: JULY 1977 TO MARCH 1980, PHASE II-B,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 3C.
W82-04082

EXPERIENCE WITH RIVERBANK FILTRATION ALONG THE RHINE RIVER,
Karlsruhe Univ. (Germany, F.R.). Carl Engler- und Hens-Bunte-Inst.-fuer Mineraloel- und Kohleforschung.
H. Sontheimer.
Journal of the American Water Works Association, Vol 72, No 7, p 386-390, 1980. 9 Fig, 2 Tab, 8 Ref.

Descriptors: *Wastewater management, *Artificial recharge, Filtration, Flocculation, Wastewater renovation, Activated carbon, *Wastewater disposal, Wastewater treatment, Induced infiltration, Ozonation, Carbon filters, Sand filters, Percolation, *Heavy metals, Organic wastes, Organic loading, Germany, *Rhine river.

Experience with land filtration for wastewater renovation along the Rhine River shows that heavy metal contaminants may be removed by precipitation if effective flocculation and filtration are applied prior to groundwater recharge. Aerobic conditions are useful for the removal of Fe and Mn, while biological oxidation of organics will occur if nitrate is present. When ground infiltration is used, complete denitrification in advanced wastewater treatment is not always desirable. Pretreatment by nitrification may avoid a high oxygen demand due to ammonia in the ground. The advantages of using small pilot plants with carbon filters instead of sand to study the effects of ground infiltration on water quality have been demonstrated in investigations using secondary effluent from a large chemical plant. Ozonation is preferred as a disinfection treatment over chlorination before infiltration, and it also induces better organics removal in the ground. Other treatment measures may have to be used before or after ground filtration to remove nonbiodegradable organics or change them into biodegradable substances. Since bank filtration along the Rhine removes about 75% of the dissolved organics present in river water, later treatment is necessary to ensure a high quality drinking water. (Geiger-FRC)
W82-04104

THE USE OF A PERFORATED BAFFLE AT THE INLET OF RECTANGULAR SETTLING BASINS,
Sao Paulo Univ., Sao Carlos (Brazil). Escola de Engenharia.
For primary bibliographic entry see Field 8B.
W82-04124

A STUDY OF THE VACUUM-FREEZING HIGH PRESSURE ICE-MELTING PROCESS,
New Mexico Univ., Albuquerque. Dept. of Chemical and Nuclear Engineering.
For primary bibliographic entry see Field 3A.
W82-04166

A STUDY OF THE IN-SITU INDIRECT FREEZING PROCESS,
New Mexico Univ., Albuquerque. Dept. of Chemical and Nuclear Engineering.
For primary bibliographic entry see Field 3A.
W82-04168

A LOCAL SOURCE CONTROL PROGRAM FOR METAL FINISHING PLANTS,
Los Angeles County Sanitation Districts, Whittier, CA.
M. P. Lo, R. C. Caballero, and J. G. Kremer.
Industrial Wastes, Vol 27, No 6, p 16-18, 21, November/December, 1981. 1 Fig, 3 Tab.

Descriptors: *Metal-finishing wastes, *Heavy metals, *Industrial wastewater, *Wastewater treatment, Cyanide, Chromium, Zinc, Copper, Lead, Nickel, Cadmium, *Los Angeles County, California.

The Sanitation Districts of Los Angeles County have successfully operated a local pollutant source control program for 6 years. There are 8000 industries, including 400 metal finishing plants, discharging 15 mgd of wastewater into this system, one of the largest municipal sewage works in the U.S. (435 mgd average dry weather flow). Phase I of the program emphasizes good housekeeping and spill prevention. Most companies can meet the California Ocean Plan standards by containing oil and grease, drag-out control, avoiding batch dumping, water conservation, and pretreatment of hexavalent Cr and cyanide wastes. Compared with the pre-source control period, reductions of pollutants as of January 1981 were cyanide, 75% (to 0.1 mg per liter); Zn, 55%; Cu, Pb, and Cr, 50% (to 0.15-0.45 mg per liter); Ni and Cd, 30%. Some larger and more complex companies have installed more extensive end-of-pipe treatments. Case histories of 2 typical plants are given. One smaller discharger (40,000 gpd) manages pollution control with good housekeeping and monitoring at capital costs of $100,000. A larger company (300,000 gpd) has installed a $1.5 million wastewater treatment plant which treats wastes separately before final polishing. (Cassar-FRC)
W82-04172

COST-EFFECTIVENESS ANALYSIS FOR ON-SITE WASTEWATER TREATMENT ALTERNATIVES,
Donohue and Associates, Inc., Sheboygan, WI.
R. E. Klink, and D. F. Pirrung.
Public Works, Vol 113, No 1, p 51-54, January, 1982. 4 Fig, 1 Tab.

Descriptors: *Septic tanks, *Cost analysis, *Sewer systems, Wastewater disposal, *Wastewater treatment, Wastewater management, Mound disposal systems.

Five on-site wastewater treatment alternatives for unsewered areas are evaluated. In general, holding tank systems are most expensive, particularly in terms of operation and maintenance costs, and conventional septic systems are the least expensive. Intermediate are individual mound systems, cluster mound systems, and sanitary sewer service. A table indicates which systems are suitable for four types of physical conditions, from sites suitable for conventional septic systems with no lot size limitations to sites not suitable for mound systems. The holding tank and sanitary sewer are usable for all types of physical conditions. Figures illustrate the cost of the five systems; the relative capital and operation and maintenance costs; cost components for 5 and 50 unit cluster-mound systems; and cost components for 5 and 50 unit sanitary sewer service. The figures are suitable for expanding costs of various systems at public information meetings. (Cassr-FRC)
W82-04185

STORM AND COMBINED SEWERS: PART OF THE TREATMENT PROCESS,
Municipal Environmental Research Lab., Edison, NJ.
For primary bibliographic entry see Field 5B.
W82-04195

AQUACULTURAL APPROACHES TO RECYCLING OF DISSOLVED NUTRIENTS IN SECONDARILY TREATED DOMESTIC WASTEWATERS--II. BIOLOGICAL PRODUCTIVITY OF ARTIFICIAL FOOD CHAINS,
California Univ., Davis. Dept. of Biology.
E. Tarifeno-Silva, L. Y. Kawasaki, D. P. Yu, M. S. Gordon, and D. J. Chapman.
Water Research, Vol 16, No 1 p 51-57, January, 1982. 1 Fig, 5 Tab, 49 Ref.

Descriptors: *Aquaculture, *Tertiary treatment, *Nutrient removal, Wastewater treatment, Food chains, Cultures, Algal growth, Carp, *Fish, Hypothalmichthys, Cladocerans, Toxicity, Ammonia, Effluents, Biomass, Productivity, Scenedesmus, Daphnia, Algae, Water pollution effects, *Ecological effects.

Biomass yields of the three food chain components, Scenedesmus (green algal), Daphnia magna (cladoceran), and Hypothalmichthys (fish) in secondary domestic wastewaters were studied. Algae needed addition of 1 ppm ferrous sulfate and aeration with air plus 5% CO2 mixture for suitable growth. These buffered cultures produced 52% higher yields of Scenedesmus (247 vs. 163 mg dry weight per liter) than the unbuffered cultures, which were unsuitable as food for cladocerans. Cladocerans fed buffered alagal cultures grew better than those fed on unbuffered cultures, as determined by conversion coefficients, specific production, and production/biomass ratio. Unbuffered, flocculated, unsettled cultures gave higher production indexes in cladocerans than supernates from unbuffered, flocculated, settled cultures. Growing herbivorous silver carp (Hypothalmichthys moltrix) in a two-stage food chain (buffered algae and fish) was not successful. Fish loss 22.3 + or - 8.5% of initial body weight within 3 weeks, and all eventually died with a weight loss of 31 + or - 4.7% in spite of supplemental feeding. Although the fish ingested large quantities of Scenedesmus, the cells were not digested. This may have been a result of ammonia toxicity. (Cassar-FRC)
W82-04197

CAPACITY EXPANSION PLANNING MODEL FOR WASTE WATER TREATMENT AND I/I CONTROL,
Ontario Ministry of the Environment, Toronto.
G. Zukovs, and B. J. Adams.
Water Resources Bulletin, Vol 16, No 4, p 601-607, August, 1980. 3 Fig, 6 Ref.

Descriptors: *Sewer infiltration, *Expansion, *Capacity, Wastewater treatment, Infiltration, Dynamic programming, Planning, Model studies, Optimization, Population growth, Sewer systems, Rehabilitation, *Wastewater facilities, Costs.

Infiltration/inflow (I/I) is considered in a dynamic programming model for planning the optimal sequence for capacity expansion of wastewater treatment plants. The model seeks a minimum present value for a defined planning period of the sum of treatment plant capital and operating costs, the cost of I/I removal, and the assumed cost of shortfalls in treatment capacity. The growth of demand for treatment capacity is nonlinear and assumed to be deterministic. Output includes the optimal timing, size, and sequence for increasing the plant capacity and for I/I removal projects. The model is illustrated by a sample problem covering 32 years. Optimal planning for this situation (74,400 population increasing at 2% per year) indicates five I/I removal projects, 2 each in years 8 and 12 and one in year 28. Three increases in treatment capacity were also indicated in years 20, 24, and 28. (Cassar-FRC)
W82-04239

5E. Ultimate Disposal Of Wastes

THE EFFECT OF SEWAGE SLUDGE ON SALT-MARSH DENITRIFYING BACTERIA,
Georgia Univ., Athens. Dept. of Microbiology.
B. F. Sherr, and W. J. Payne.
Estuaries, Vol 4, No 2, p 146-149, June, 1981. 3 Tab, 21 Ref.

Descriptors: *Biodegradation, *Denitrification, *Sludge disposal, *Waste assimilative capacity, Sludge, Marshes, Sludge digestion, Nitrogen, Waste disposal, Degradation, Ecological effects, Soil bacteria, Land disposal, Decomposition, Microbial degradation, Toxicity, *Salt marshes.

Air dried pulverized secondary sewage sludge was applied twice monthly for 9 months to the surface of two circular 100 sq m plots located on Spartina alterniflora marsh sites to test the marsh's ability to assimilate sludge nitrogen. Soil slurries were taken to assess the denitrification ability of the soil at various depths by the nitrous oxide reductase assay. After nine months, a significant decrease in the denitrification potential was observed in the upper 15 cm of the soil. Laboratory tests showed that the sludge had an immediate inhibitory effect on the potential soil denitrification rates, suggesting that the in situ potential arose from a direct toxic effect of the sludge on the respiratory process of soil bacteria. These results could not have been predicted from the results of other such studies of responses of soil bacteria to sewage sludge, which ranged from adaptation to it to decomposition of it. The responses of higher plants to sludge treatment likewise vary from study to study, although S. alterniflora has been shown to exhibit increased productivity in the presence of sewage sludge. (Geiger-FRC)
W82-03770

CONSTRUCTION OF CONTAINMENT FACILITY FOR DREDGED MATERIALS BEGINS,
For primary bibliographic entry see Field 5G.
W82-03839

PROCEDURE FOR EVALUATING THE GEOLOGIC INTEGRITY OF EXISTING HAZARDOUS WASTE SITES IN LOUISIANA: CASE HISTORIES,
Geological Survey, Baton Rouge, LA.
For primary bibliographic entry see Field 5A.
W82-03932

PREDICTION OF LEACHATE ACCUMULATION IN SANITARY LANDFILLS,
Wisconsin Univ. Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W82-03934

DESIGN OF A LEACHATE COLLECTION SYSTEM FOR A SLUDGE FILLED LANDFILL,
Gingery Associates, Inc., Englewood, CO.
C. A. McKnight, and D. T. Schultz.
In: Fourth Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 28-30, 1981. p 191-203, 1981. 3 Fig, 2 Ref. Department of Engineering & Applied Science, University of Wisconsin--Extension, Madison, WI.

Descriptors: *Leachates, *Landfills, Dupuit-Forchheimer theory, Model studies, *Infiltration, Sludge, Subsurface drainage, Percolation, Data interpretation, Substrates, Biological wastewater treatment, Waste dumps, Saturation.

Leachate generated at a landfill site containing biological sludge comes from two principal sources: biological decomposition and incident precipitation. The leachate generated due to decomposition is a linear function of sludge volume within the landfill; that generated due to incident precipitation is a linear function of exposed surface area for any given precipitation intensity. With the increased environmental concern for the impact of landfill leachate on groundwater quality, the need has arisen for a rational means of designing leachate collection systems. A one-dimensional analysis of subsurface flow is described as a tool for the design of such a system. The flow system can be reasonably approximated as being one-dimensional since the gradients perpendicular to a subsurface drain are typically much greater than the longitudinal slopes of the subsurface drain. The Dupuit-Forchheimer approximations are assumed to apply, in that the constant head line is assumed to be vertical. The decay constant is the most difficult parameter to predict, and should, when at all possible, be based on observed rates of decomposition

or values reported in the literature. Direct measurement of liberated water and samples of the substrate taken at various depths over time will give an indication of decay rate, but are often influenced by precipitation, evaporation, infiltration/exfiltration through the liner, and surface runoff. Some of these parameters are virtually impossible to measure and difficult to estimate. Although the analysis was developed for use in a sludge-filled landfill, it is applicable in any landfill for which leachate generation rates can be predicted. (Garrison-Omniplan)
W82-03935

IMPROVED ANALYTICAL METHODS FOR THE DESIGN OF LEACHATE COLLECTION SYSTEMS,
Residuals Management Technology, Inc., Madison, WI.
J. F. Scharch.
In: Fourth Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 28-30, 1981. p 228-237, 1981. 4 Fig. Department of Engineering & Applied Science, University of Wisconsin--Extension, Madison, WI.

Descriptors: *Landfills, Comparison studies, *;Leachates, Projections, Data interpretation, *Infiltration, *Linings, Percolation, Construction methods, Clay loam, Soil types, Sanitary landfills, Leakage.

This paper discusses how performance of alternate designs of leachate collection systems for landfill sites can be evaluated and optimized with Wong's analysis method, which evaluates the vertical and horizontal velocity of the leachate that moves through the various layers of a landfill in response to the force of gravity. The method incorporates variables in a series of equations through which the design efficiency is calculated: base slope, yearly infiltration, collector pipe spacing, liner thickness, refuse porosity, and liner and refuse permeability. In general, it was found that optimizing a design with Wong's analysis method can dramatically reduce the net volume of leachate escaping from a site. For a hypothetical typical landfill, collection efficiency is as low as 17 percent if the collection efficiency of the liner section is computed for an assumed net annual infiltration rate of ten centimeters for each refuse density, and high-density refuse is placed on the liner. When low-density refuse is placed over the liner, collection efficiency increases to 49.1 percent. This typical landfill is compared with three design alternatives. Case I employs a centrally located sump and replaces the collection pipe system with a sand blanket, achieving a collection efficiency of 94.1 percent. Case II uses available soils in areas where clay borrow soils are scarce, and has a collection efficiency of 89.4 percent. The increased workability of the soils makes this liner design less expensive to construct than a site lined with imported clay. Case III uses on-site fine-grained soils and has a collection efficiency of 90.1 percent. (Garrison-Omniplan)
W82-03936

PERFORMANCE STUDIES OF VARIOUS LANDFILL AND IMPOUNDMENT LINERS,
Soil Testing Services of Wisconsin, Inc., Green Bay.
D. J. Hermann, and S. B. Tuttle.
In: Fourth Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 28-30, 1981, p 250-265, 1981. 10 Fig, 2 Tab, 13 Ref. Department of Engineering & Applied Science, University of Wisconsin--Extension, Madison, WI.

Descriptors: Permeameters, Coatings, *Landfills, Soil types, *Leachates, *Groundwater contamination, Shales, Land disposal, Permeability, Infiltration, Clays, Waste management, *Waste disposal, *Linings.

During the past decade, numerous incidents of groundwater pollution from chemical spills and landfill seepage have been reported, and have shown that even sequestered reservoirs of potable water are vulnerable. Groundwater provides water for about half the population of the U.S. Many liner materials, both natural and synthetic, have been proposed and used to isolate land disposal sites, with varying results. Most liner failures have been attributed to poor installation practices. The choice of a liner is dependent on several factors, including permeability, waste characteristics, cost/economics, and physical/chemical characteristics. This paper describes commonly used natural and synthetic liners, and includes several case studies. One compares the permeability of eight commercial sealants to leachate, and reports that permeability of the parameters fluctuated widely for most sealants, especially after full permeation of the leachate. The reasons for the fluctuations are unknown, but may be attributed to exchange and re-exchange of contaminants, methane-producing bacteria, or barometric fluction. Another case study evaluated shale as a landfill liner and found that it exhibited properties comparable to naturally occurring clay, and that it could be adequately broken up and processed in a manner similar to clayey soils in the same geographic area. The shale material was recommended as a liner for the entire quarry. A third study, which contrasted an artificial liner (chlorinated polyethylene) with a clay liner at a midwestern site, concluded that a synthetic liner is particularly suitable for the proposed disposal site. (Garrison-Omniplan)
W82-03938

APPLICATION OF COMPUTER MODELING FOR THE INVESTIGATION OF GROUNDWATER CONTAMINATION,
GeoTrans, Inc., Reston, VA.
W. J. Miller, III, and L. R. Silka.
In: Fourth Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 28-30, 1981. p 361-382, 1981. 10 Fig, 13 Ref. Department of Engineering & Applied Science, University of Wisconsin--Extension, Madison. WI.

Descriptors: *Computer models, *Model studies, *Mathematical models, *Simulations, *Waste disposal, Wastewater disposal, Land disposal, Conductivity, Model testing, Permeability coefficient, Monitoring, Wells, Anisotropy.

Mathematical computer models represent one type of tool being used by hydrogeologists and engineers to understand hydrogeologic flow systems. The models are used as an aid to the siting, design, operation, and clean-up of waste disposal sites. The USGS two-dimensional ground-water flow model was used to evaluate the remedial measures controlling landfill leachate migration from Army Creek Landfill in New Castle County, Delaware. Transient simulations were run from 1953-1973 in six pumping periods. Some conclusions were that: (1) for a given well spacing and head differential in the wells, the duration of the test will be related inversely to hydraulic conductivity and directly to porosity; (2) single-well flow tests should be performed on the first well before drilling the second; (3) if the hydraulic conductivity of the aquifer is low, a small well spacing will be required to conduct the test in a reasonable amount of time; and (4) analysis of the field test data can use a two-dimensional model if the anisotropy ratio is greater than 100; otherwise a three-dimensional model may be required. It is likely that model results could be used to guide the placement of monitor wells to assist in detecting movement of contaminants from disposal sites. Predictive runs to aid in decision-making have not been completed. Another use of modeling in study design, conducted for a proposed radioactive waste respository in Denmark, is discussed. (Garrison-Omniplan)
W82-03939

SEALING OF LAGOONS AND PONDS: PROPOSED QUALITY REQUIREMENTS FOR SOIL LINERS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W82-03941

TREATMENT OF PHENOL AND SUBSTITUTED PHENOLS WITH AN ANAEROBIC ACTIVATED CARBON FILTER,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-03959

NITROGEN REMOVAL IN A SUBSURFACE DISPOSAL SYSTEM,
Dvirka and Bartilucci, Long Island, NY.
For primary bibliographic entry see Field 5D.
W82-04001

EXPERIENCE WITH RIVERBANK FILTRATION ALONG THE RHINE RIVER,
Karlsruhe Univ. (Germany, F.R.). Carl Engler-und Hens-Bunte-Inst.-fuer Mineraloel- und Kohleforschung.
For primary bibliographic entry see Field 5D.
W82-04104

FEASIBILITY STUDIES ON LIQUID ION EXCHANGE FOR ALUM RECOVERY FROM WATER TREATMENT PLANT SLUDGES,
Michigan State Univ., East Lansing. Dept. of Civil Engineering.
D. A. Cornwell, and R. M. Lemunyon.
Journal of the American Water Works Association, Vol 72, No 1, p 64-68, January, 1980. 1 Fig, 3 Tab, 12 Ref.

Descriptors: *Aluminum, *Ion exchange, *Water treatment, Alum, Extraction, *Heavy metals, Kinetics, Feasibility studies, Sludge.

Over 95% of dissolved aluminum was recovered from water plant sludges using a batch ion exchange process. The extractant as an equal molar mixture of mono and di(ethylhexyl) phosphoric acid diluted with kerosene. Minimum impeller speed for pH 2.0 and initial Al concentration of 1000 mg per liter was 4 m per sec. A feed at pH of 4.0 extracted twice as much Al as feed at pH 2.0. The extractant had a high selectivity for Al in solutions containing 500 mg per liter Al and 25 mg per liter Cu, Cd, Mn, An, Fe, Fe, and Cr. Selectivity ratios were 90, 140, 170, 930, 75, 6, and 28, respectively. 6N HCl and 9N H2SO4 were equally effective in the process. (Cassar-FRC)
W82-04107

DISPOSAL AND HANDLING OF WATER TREATMENT PLANT SLUDGE,
Greeley and Hansen, Chicago, IL.
C. W. Reh.
Journal of the American Water Works Association, Vol 72, No 2, p 115-118, February, 1980. 6 Fig, 1 Ref.

Descriptors: *Sludge disposal, *Water treatment, Sludge thickening, Sludge lagoons, Sludge drying, Lagoons, Land disposal, Alum, Coagulation, Magnesium carbonate, *Wastewater treatment, Chemical recovery, *Wastewater disposal.

Past, present, and future practices for disposal of water treatment plant sludges are described. The oldest disposal method, now being discontinued, is discharge to a sewer or waterway. Other sludge handling techniques are lagooning, drying beds, mechanical concentration, alum reclamation, and recalcining (in plants that soften water by calcium carbonate removal). Magnesium carbonate is under development as an alternate coagulant. Stricter regulations on sludge disposal may require more extensive treatment. Future developments include presedimentation to produce an easily dewatered mud, roughing filters to reduce the volume of floc produced, use of polymers as coagulants, improved concentrating devices, conditioning of side streams for reuse, reclamation of chemical reagents, and recalcining. (Cassar-FRC)
W82-04126

WASTE WATER DISPOSAL THROUGH A COASTAL AQUIFER,
Youngstown State Univ., OH. Dept. of Civil Engineering.
I. A. Khan.
Water Resources Bulletin, Vol 16, No 4, p 608-614, August, 1980. 5 Fig, 1 Tab, 9 Ref.

Descriptors: *Coastal aquifers, *Wastewater disposal, *Injection wells, Aquifers, Wells, Carbonate aquifers, Oahu, *Hawaii, Model studies.

Electric analog modeling was used to study the feasibility of disposing treated wastewater in wells drilled 220 ft deep into a partially confined coastal aquifer at Waimanalo, Oahu, Hawaii. The high permeability, low storativity, and high salinity of this 100-200 ft thick limestone aquifer make it highly suitable for wastewater disposal. A maximum of 20,000 gpm can be injected into 3 deep wells under a hydraulic head of 8 ft, under gravity conditions. The waste will enter the ocean at depths of 100-200 ft. Costs were believed to be less than those of a conventional ocean outfall. Water from this aquifer is not suitable for any municipal, industrial, or agricultural uses because it contains up to 21,000 ppm total chlorides and 38,000 ppm total dissolved solids. Therefore, the wastewater injection would not destroy any potential fresh water supplies. (Cassar-FRC)
W82-04231

5F. Water Treatment and Quality Alteration

EFFECT OF WATER TREATMENT ON MUTAGENIC POTENTIAL,

Jardine Water Purification Plant, Chicago, IL.
For primary bibliographic entry see Field 5A.
W82-03776

THE COSTS OF INTERNAL COROSION IN WATER SYSTEMS,

Collins, Ryder and Watkins, Inc., Tacoma, WA.
R. A. Ryder.
Journal of the American Water Works Association, Vol 72, No 5, p 267-279, May, 1980. 2 Fig, 24 Tab, 14 Ref.

Descriptors: *Corrosion control, *Cost-benefit analysis, *Plumbing, *Water supply systems, Economic aspects, Water treatment, Water distribution, Pipes, *Seattle, Washington.

In Seattle, Washington, Annual corrosion costs for consumers' plumbing systems are much higher than corrosion costs in water distribution systems, $7 million vs. $400,000. This was determined by a detailed analysis of types and numbers of structures, age, proportion of plumbing materials installed in various age groups of structures, rate of deterioration, and repair and replacement conditions and costs. The major portion of corrosion costs in urban areas is incurred by residential consumers. About 75% of the buildings contain galvanized steel pipe and about 25%, copper pipe. Benefit/cost ratios of a corrosion control program for this area exceed 5:1 for consumers. Costs are 0.5-1.7 cents per 1000 gal or $1.40 annually per residential unit. Savings per unit are $7.20. Greatest savings are realized by newer plumbing systems, since old, deteriorated piping will have to be replaced in spite of corrosion control measures. Service life for copper tubing will be extended 3 or 4 fold and for galvanized steel pipe, by 50%. Recommended corrosion control measures for this water supply are pH control with lime, sodium bicarbonate, and sodium silicate. (Cassar-FRC)
W82-03809

MUNICIPAL ION EXCHANGE: WAITING TO TAKE OFF,

Water Purification Associates, Cambridge, MA.
C. Calmon.
Water/Engineering and Management, Vol 128, No 11, p 33, 34, 36, November, 1981. 10 Ref.

Descriptors: *Ion exchange, *Water treatment, Municipal water, Membrane processes, Resins, *Desalination, Demineralization, Drinking water, Water softening.

Municipal water treatment by ion exchange is receiving more attention, perhaps in part due to cost considerations in water treatment. Continuous computer-current ion exchange units for softening have been installed in some communities, but their use has met with little success. Solids are more difficult to move than liquids, and well trained operators are needed to maintain these units. Tests in coastal cities showed that seawater could be used as a regenerant for ion exchangers. Ion exchange plays an important role in the application of coagulant aids. The rate of settling of particles in water depends on the diameter of the particle and its density, and is inversely proportional to the viscosity of the water. Thus, as temperature drops, the settling rate of flocs formed in coagulating systems is lowered. The presence of certain compounds in some waters and the lowering of water temperature interferes with the growth of flocs required for rapid settling. Certain clays have been found to aid in the settling of flocs. Nitrate-nitrogen in drinking water can be controlled through ion exchange. Desalination of brackish waters can be accomplished successfully with ion exchange membranes. However, there are problems with the process, the most serious of which is fouling of the membranes. Another use for ion exchange resins is as carriers. Multiplication of organisms is another ion exchange problem. Nutrients develop easily on ion exchange resins unless the bed is disinfected on a scheduled basis. (Baker-FRC)
W82-03837

GROUND-LEVEL VERSUS ELEVATED STORAGE,

Fort Wayne Water Utility, IN.
D. L. Foland.
Journal of the American Water Works Association, Vol 74, No 10, p 525-527, October, 1981. 1 Fig.

Descriptors: *Water distribution, *Municipal water, Water conveyance, Fort Wayne, Indiana, Storage, *Water storage, Water supply, *Fort Wayne, Indiana.

The storage of treated water has two purposes. First, such storage provides a reasonable reserve to meet peak domestic needs. Second, storage provides a large reserve for fire protection purposes. The evolution of a storage system in Fort Wayne, Indiana is described, and attempts are made to show how various factors were considered in its development. Some of these factors include past and projected growth of the system, outmoded elevated storage facilities, and limitations of the present storage and trunk main system. This expanded treatment facility will utilize all the land now available for this purpose at the central location. A five year plan has been prepared to improve the distribution system to meet the demands for the year 2000 and beyond and to offset the recurring need for additional plant capacity. Four storage and repumping facilities are planned. For long range plans the water distribution system has recently been modeled on an in house computer, initially for distribution analysis and engineering design purposes. It is hoped that pressure and flow sensors will be placed within the system and the data periodically gathered and transmitted to the computer for analysis so that the computer can control the main pumping station and satellite repumping facilities. This will ensure that the system can adequately meet the needs of its customers at all times and under all conditions. (Baker-FRC)
W82-03865

CLARIFICATION WITH MICROSAND SEEDING. A STATE OF THE ART,

Omnium de Traitement et de Valorisation, Courbevoie (France).
J. Sibony.
Water Research, Vol 15, No 11, p 1281-1290, November, 1981. 1 Fig, 2 Tab, 3 Ref.

Descriptors: *Clarification, *Sand, *Water treatment, Flocculation, Coagulation, Microsand, Fluidized beds, CYCLOFLOC units, FLUORAPID units, *France.

Microsand (particles with a grain size of 20-100 microns) is used as an additive in the coagulation process during water treatment. In France this process has been actively developed since patenting in 1964. Jar tests demonstrate that microsand added to FeC13 and aqualgine produces results 3 times faster than without microsand. Generally 1-2 g per liter of sand is sufficient. A CYCLOFLOC unit operating at Orleans, France, is described. After clarification, the microsand-sludge settles to the bottom of the tank, from which it is pumped into a hydrocyclone for separation and return of cleaned sand to the treatment tank. The FLUORAPID unit clarifies water in 2 stages: (1) primary clarification, in which the microsand-floc particles operate in a fluidized bed and are removed from the top of the unit, and (2) lamellar separation. (Cassar-FRC)
W82-03880

PHOSPHATE IN WATER: I. REDUCTION USING NORTHERN LIGNITE FLY ASH,

South Dakota State Univ., Brookings. Dept. of Plant Science.
L. O. Fine, and W. P. Jensen.
Water Resources Bulletin, Vol 17, No 5, p 895-897, October, 1981. 1 Fig, 3 Tab, 9 Ref.

Descriptors: *Phosphorus removal, *Fly ash, Acidity, Temperature, Water quality, Water pollution sources, Phosphates, Eutrophication, *Lakes.

Various quantities of fly ash were mixed with standard solutions containing orthophosphate in known amounts, using a constant temperature mechanical shaker. The mixtures were agitated for 30 minutes, quickly filtered, cooled to room temperature and analyzed for orthophosphate content using an ascorbic acid method. In order to test phosphate removal potency of fly ash on lake water, samples were taken from a number of lakes in northeastern South Dakota. Analysis of the lake water samples showed that all of the phosphorus in solution was tied up as complex phosphate materials and the levels of orthophosphate were too small to detect using the ascorbic acid method. A simulated lake water sample was then prepared by equilibrating sludge dredged from the bottom of Dry Lake, located near Castlewood, South Dakota, with lake water from Dry Lake and Lake Poinsett. The sludge contained appreciable amounts of orthophosphate which desorbed rapidly into the lake water. Samples of the lake water thus prepared were treated with fly ash, mixed at 80 degrees C for 10 minutes, filtered, and the solutions analyzed for orthophosphate content. Repeated trials in the laboratory with wastewaters from a local municipal secondary treatment plant readily reduced solution phase phosphates from 11 to less than 1 ppm P with short time contact. Further testing demonstrated that solution phosphate reduction was a very sensitive function of pH. The optimum pH level appeared to be around 10, although considerable efficacy was noted at lower pH levels. (Baker-FRC)
W82-03882

CLOSED-LOOP STRIPPING ANALYSIS AS A TOOL FOR SOLVING TASTE AND ODOR PROBLEMS,

Southern California Metropolitan Water District, LaVerne.
M. J. McGuire, S. W. Krasner, C. J. Hwang, and G. Izaquirre.
Journal of the American Water Works Association, Vol 73, No 10, p 530-537, October, 1981. 9 Fig, 4 Tab, 24 Ref.

Descriptors: *Water quality, *Chemical analysis, Measuring instruments, Taste, *Odor control, Odor producing algae, Algae, Sediments, Drinking water, *Potable water, *Water treatment, Metropolitan Water District of Southern California.

The purpose of the paper is to explore the techniques available to detect and control odor problems in water supplies and to introduce the closed loop stripping analysis (CLSA) technique as an integral part of the strategy. The CLSA technique allows identification of several taste and odor causing organic substances in water, sediments, and cultures at low nanogram per liter levels. CLSA is as sensitive as or more sensitive than the human nose and qualitatively more reliable. Extensive data assembled before and during odor episodes, along with multiple sources of raw water and a flexible distribution system, enable the Metropoli-

tan Water District of Southern California to control earthy, musty odors. However, for earthy, musty odors in this system, sensory techniques such as the threshold odor number were supplemented by taste testing. Grassy and fishy odors tended to mask and confuse sensory techniques. Laboratory microbiological methods such as unialgal and actinomycete culturing played an integral part in isolating the source of 2-methylisoborneol in Lake Mathews. Scuba divers provided valuable observations on the extent and location of blue green algal growths. (Baker-FRC)
W82-03886

EVALUATING ADSORBENT FILTER PERFORMANCE FOR ENTERIC VIRUS CONCENTRATIONS IN TAP WATER,
AMF Cuno, Meridan, CT.
M. D. Sobsey, R. S. Moore, and J. S. Glass.
Journal of the American Water Works Association, Vol 73, No 10, p 542-548, October, 1981. 2 Fig, 6 Tab, 14 Ref.

Descriptors: *Analytical techniques, *Drinking water, *Viruses, *Water treatment, Potable water, Water quality, Microbiological studies, *Filters, Evaluation, Separation techniques, Public health, Human diseases.

Evaluations were made of a recently developed electropositive adsorbent filter for concentrating small quantities of viruses from large volumes of water. Its operational limits were compared with those of a conventional electronegative adsorbent filter. Filter performance limits were determined with respect to adsorption flow rate, tap water process volume, stability of adsorbed virus during storage, and ability to concentrate several enteric viruses. These findings were used to assess the applicability of filter type 1 (the electropositive adsorbent filter) as an effective adsorbent in virus concentration procedures. This study confirmed that the electropositive type 1 filters offer distinct advantages. One important advantage is the ability of type 1 filters to adsorb viruses efficiently at much higher pH levels than strongly electronegative filters. In both small and large volume experiments virus recoveries with type 1 filters from pH 7.5 tap water were equivalent to or greater than those with type 2 filters from pH 3.5 tap water with or without 5 mM magnesium chloride added. The ability of type 1 to recover viruses efficiently at ambient water pH levels up to 7.5 eliminates the need for acidification and salt addition with cumbersome chemical additive systems and thereby greatly simplifies the virus concentration procedure. Seasonal changes in water quality factors influenced virus adsorption and recovery efficiencies with both filter types. Both filter types were able to process water volumes up to 1 L/square centimeter at flow rates up to 30 mL/min per square centimeter without a substantial loss in virus adsorption and recovery efficiencies. It was concluded that type 1 filter was an effective virus adsorbent. (Baker-FRC)
W82-03887

GAS CHROMATOGRAPHIC TECHNIQUES FOR CONTROLLING ORGANICS REMOVAL PROCESSES,
Municipal Environmental Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W82-03888

LIMITATIONS OF STANDARD COLIFORM ENUMERATION TECHNIQUES,
Oregon State Univ., Corvallis. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W82-03889

NOTES AND COMMENTS: LEACHING OF ORGANICS FROM A PVC-POLYETHYLENE-PLEXIGLASS PILOT PLANT,
Montgomery (James M.), Inc., Pasadena, CA.
P. Kreft, A. Trussell, J. Lang, M. Kavanaugh, and R. Trussell.
Journal of the American Water Works Association, Vol. 73, No 10, p 558-560, October, 1981. 1 Fig, 3 Tab, 2 Ref.

Descriptors: *Drinking water, *Chemical analysis, Organic compounds, Pollutants, Water treatments, Water pollution sources, *Pilot plants, Testing procedures, *Water treatment facilities, *Plastics, Pasadena, California.

A water treatment pilot plant constructed from conventional materials was tested for its ability to release or remove organic compounds. Prior to this study the pilot plant had been used over a two year period for four water treatment studies and one wastewater filtration study. The pilot plant was operated with one complete process train consisting of the influent module, one flocculation unit, one sedimentation tank and two filter modules. The raw water used was Pasadena, California, tap water delivered to the influent model via 15 meters of garden hose made of plasticized PVC. Testing conducted over 36 hr allowed analysis for total organic carbon (TOC), purgeable volatile organics (VOA), and base-neutral and acid extractable organics (BNA). TOC test results indicated no significant change before or after pilot plant treatment. The VOA analysis indicated no significant change occurring from influent to effluent for 22 compounds detected. The carbon tetrachloride and trichlorethylene concentrations did decrease, probably as a result of volatilization from splashing. A minor increase was noted in concentrations of dichlorobromomethane, dibromochloromethane, and bromoform, probably as a result of the continued action of chlorine. The results of this study indicate that it is possible to conduct pilot studies concerning organic matter in water with equipment made from judiciously selected plastic materials. (Baker-FRC)
W82-03890

TAILORING DESIGN OF TREATMENT PLANTS TO LOCAL CONDITIONS,
Camp, Dresser and McKee, Boston, MA.
P. W. Prendiville.
Journal of the American Water Works Association, Vol 73, No 10, p 507-513, October, 1981. 3 Fig.

Descriptors: *Water treatment facilities, *Design criteria, Water treatment, Waste disposal, Water quality, Water supply, Planning, Construction, Water management, *Comparison studies, Sydney, Australia, Manila, Springfield, Massachusetts, Rochester, Long Island, New York.

A description and comparison is offered of five water treatment systems and supply sources as a basis for discussing tailoring the design of treatment facilities to local conditions. The five treatment systems are located in Sydney, Australia; Manila, Philippines; Springfield, Massachusetts; Rochester, New York; and Long Island, New York. Local conditions which must be considered in designing treatment plants include: water quality, existing treatment facilities, sources of supply and ability to regulate the supply, requirements for labor intensive design versus automation, climatic conditions, ability to maintain equipment, available emergency measures, availability and cost of chemicals and facilities available for disposal of solid wastes. As a result of these investigations, common designs were established for the filter media, the filter loading rates, and the graduation of media. The pretreatment processes and filters, however, had different designs for dispersing chemicals into the water, depth of media, contact time for coagulation, flocculation, and filter bottoms and backwashing. These differences and others were due to local conditions. (Baker-FRC)
W82-03893

ADSORPTION OF PCBS BY CELLULOSE FIBER FILTERAIDS AND CARBONACEOUS ADSORBENTS USED FOR WATER TREATMENT,
Illinois State Geological Survey Div.,
S. F. J. Chou, and R. A. Griffin.
In: Fourth Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 28-30, 1981. p 238-249, 1981. 2 Fig, 4 Tab, 20 Ref. Department of Engineering & Applied Science, University of Wisconsin--Extension, Madison, WI.

Descriptors: *Polychlorinated biphenyls, Lake sediments, *Adsorption, Aroclors, Tissue analysis, *Activated carbon, Adsorbents, Hazardous materials, Lakes, Toxicity, Ecology, Water quality, *Water treatment.

The entrance of polychlorinated biphenyls (PCBs) into the food chain, their accumulation in animal and human tissues, and their toxic effects have been well documented in recent years. The PCB burden in the sediments of the Great Lakes-St. Lawrence River system represented the greatest PCB reservoir in the continental U.S. This accumulation is due, in part, to industrial discharges in past years that highly contaminated the sediments of certain localized areas such as the harbor at Waukegan, IL. While cleanup efforts have begun, complete removal may not be either technically or economically feasible. This study, to assess the PCB adsorption properties of several water treatment materials, found that activated carbon had an adsorption constant about fourteen times larger than an average amount of Solka-Floc, and about 8.5 times larger than Ambersorb XE-348. PCBs used in the laboratory study were water-soluble Aroclor 1242 and 1254. Freundlich adsorption isotherm plots yielded linear regression lines with coefficients of correlation of at least 0.98 for all the tested adsorbents. PCBs were strongly adsorbed by all the adsorbents, and all could be used to reduce the PCB levels in water. Higher chlorinated isomers were preferentially adsorbed over lower chlorinated isomers on Solka-Floc and to a lesser extent on the activated carbon. Ambersorb XE-248 showed the opposite tendency. Both carbonaceous adsorbents gave better uniformity than the Solka-Floc in removal of PCB isomers from water. All samples and standards were analyzed on a Perkin-Elmer Sigma I gas chromatograph equipped with dual electron capture detectors. (Garrsion-Omniplan)
W82-03937

COLOR REMOVAL FROM GROUNDWATER BY ION EXCHANGE AND SLUDGE RECYCLE TECHNIQUES,
Mississippi State Univ., Mississippi State. Water Resources Research Inst.
B. N. Ficquette.
Available from the National Technical Information Service, Springfield, VA 22161, as PB82-197989, Price codes: A07 in paper copy, A01 in microfiche. MS Thesis, December, 1981. 119 p, 81 Fig, 8 Tab, 42 Ref. A-132-MS(3), 14-34-001-0126.

Descriptors: *Ion exchange, Membrane processes, Oxidation, Coagulation, Adsorption, *Color removal, *Water treatment, Sludge recycling, *Strong base ion exchangers, Weak base anion exchangers, *Ultrafiltration, UV-radiation, Coagulation.

Several towns in Mississippi and in the southeastern United States are plagued with groundwater which exceeds the secondary maximum contaminant level of 15 color units, set by the United States Environmental Protection Agency. The primary objective of this study was to investigate two treatment techniques for removing the organic color from a groundwater. Ion exchange was the first treatment technique which was investigated. Eight different resins were tested in batch studies, and two pilot plant studies were conducted at a well site. Both the batch study, and the pilot plant studies indicated that IRA-904, a Rohm and Haas strong base styrene-divinylbenzene anion resin, performed the best. A batch study, which was conducted to determine the best regenerate, indicated that a 10 percent solution of 5 parts NaCl to 1 part NaOH was the best regenerate for resin, IRA-904. In the second pilot study the regenerate solutions were used twice, and it appeared that the resins were satisfactorily regenerated with the used regenerate solutions. Resin, IRA-904, was regenerated seven times, and a loss in capacity was experienced with each regeneration. In the coagulation study ferrous sulfate, ferric sulfate, and alum were

administered along with chlorine, lime, and starch in several standard jar tests. The results indicated that alum, when used alone, performed best as far as color removal, but dosages of 250 mg/l to 300 mg/l were required to remove all the color from the raw water. When the alum sludge was recycled, it was discovered that a 10 percent by volume recycle of sludge along with an additional 10 mg/l of new alum could remove all the color from the raw water.
W82-03956

AUTOMATED TREATMENT PLANT KEEPS ROTTERDAM DRINKING WATER FLOWING.
Water Services, Vol 85, No 1027, p 468, 471-472, September, 1981. 3 Fig.

Descriptors: *Water treatment, *Automation, Computers, Netherlands, *Rotterdam, *Kralingen, Water management, Water supply development, Water demand, *Water treatment facilities.

In 1977 a new advanced water treatment plant was put into operation at Rotterdam-Kralingen, next to the place where fresh water production began more than a century before. The Kralingen plant is a realization of the most advanced state of technology in water treatment - both in the process itself and in its control. Supplied by pipeline from both the Biesbosch and Berenplaat reservoirs, the Kralingen Plant employs a new high-rate process, eliminating the use of chlorine until immediately before storage. This is done to avoid the recently established adverse effects of chlorine on organic materials contained in natural waters. Raw water is dosed with iron sulfate and other chemicals to encapsulate many impurities by means of a coagulation process. A sedimentation step, using lamella separators, causes the coagulated particles to settle to the bottom as sludge, which is then removed. Partially clarified water is then subjected to ozonization, during which bacteria and other impurities are rendered harmless. The water is dosed with iron sulfate and passed through one of 12 rapid downflow filters. It then goes to a battery of active-carbon filters, which eliminate any unpleasant taste. After postchlorination, the pure water is stored in one of two mushroom-shaped reservoir tanks. An automated processing and control system has been developed and installed. The computerized system for supervision and control was supplied by Philips Nederland and is based on two P 857 microcomputers, connected by a high speed data channel in a master/slave arrangement. (Baker-FRC)
W82-04004

CHEMICAL TREATMENT OF SMALL REMOTE WATER SOURCES,
A. C. Richmond.
Water Services, Vol 85, No 1027, p 467-468, September, 1981. 3 Fig.

Descriptors: *Water treatment, Rural areas, Water management, Drinking water, *Chemical treatment, *Potable water, *Hypochlorite.

Reliable chemical treatment of small remote water sources in the absence of electricity or usable pressure head has usually been accomplished by hypochlorite drip feed devices. The several types vary in sophistication, but often rely on the head within a bottle containing hypochlorite and an orifice-controlled drip rate. It has proved virtually impossible to impose any true proportional dose features on this type of arrangement. A new device has been produced which has three main component parts: a water tank of about 150 liters capacity, the self powered adjustable dosing head with an integral 10 liter capacity chemical reservoir, and a quick acting, high capacity syphon. Water enters the 150 liter tank at a rate between 2270 and 100,000 liters/day. As the level in the water tank rises, a ball float lifts a small container of sodium hypochlorite to a point where a fixed plunger enters the chamber to a pre-set depth and displaces a controlled amount of the contents. The displaced hypochlorite is directed into the main tank by a special pivoted tube, which moves clear when the chamber descends into the hypoclorite reservoir where it is replenished for the next cyle. As the water in the main tank reaches an appropriate level, the syphon actuates and discharges the contents of the tank into a service reservoir or tank immediately below the unit. Because the unit is based on cyclic operation, within the range of the machine, the dose of hypochlorite is proportioned to the incoming flow of water. (Baker-FRC)
W82-04005

OPTIMIZATION OF LOOPED WATER DISTRIBUTION SYSTEMS,
SCS Engineers, Inc., Long Beach, CA.
For primary bibliographic entry see Field 6A.
W82-04045

CONTROLLING BED LOSSES OF GRANULAR ACTIVATED CARBON THROUGH PROPER FILTER OPERATION,
ICI Americas, Inc., Wilmington, DE.
A. P. Ferrara.
Journal of the American Water Works Association, Vol 72, No 1, p 60-63, January, 1980. 7 Fig, 4 Tab.

Descriptors: *Activated carbon, *Filter media, *Backwash, Filtration, *Water treatment, Adsorption, Particle size, Bed loss control.

Bed losses of granular activated carbon in water filters can be reduced to a minimum with proper bed size, and operating procedures. Important causes of filter media loss are lack of sufficient freeboard for bed expansion during backwashing and excessive wash rates. Unsuitable wash rates may result from faulty gages or improperly trained operators. Particle size, wash water temperature, and wash trough area must also be considered in determining the optimum wash rate. Entrapped air must be allowed to boil off before reaching the full backwash rate. A method is presented to predict carbon losses. It involves gathering information on existing conditions, taking a core sample of the media, and backwashing it in a transparent column to obtain a bed expansion curve. From this the maximum wash rate can be estimated. Plants should measure the bed heights on installation and quarterly. Particle size should be determined on installation and every 6 months to estimate the remaining bed life. (Cassar-FRC)
W82-04089

INTERAGENCY CONNECTIONS: INSURANCE AGAINST INTERRUPTIONS IN SUPPLY,
Boyle Engineering Corp., Corona Del Mar, CA.
D. B. Boyle.
Journal of the American Water Works Association, Vol 72, No 4, p 192-195, April, 1980. 1 Fig.

Descriptors: *Interagency cooperation, *Water exchange, Water distribution, *Water supply systems, *Orange County, *California, Water conveyance, Water delivery, Water importing, Water transfer, Maintenance, Storms, Algae.

Interconnection among water supply systems has been a successful means of maintaining service in Southern California during shutdowns or emergencies. Advantages of these connections are adequate water for fire protection, delivery of a temporary supply to a newly developed area, alternate sources in case of contamination, lower fire insurance rates, and sharing costs of transmission facilities. In Orange County, California, 12 major water supply agencies depend on interconnections or stored water for alternative supplies; groundwater and additional surface water are not available. Four cases illustrate the use of interagency connections. Maintenance of Lake Mathews outlet valves was performed for several days without customers being aware of any differences in water service. Several storms in 1969 ruptured a 54 inch main near the city of Orange. During the 30 days needed for repairs interconnections with other agencies and diversion from an irrigation water source met water requirements satisfactorily. In 1968 algal growth in a reservoir produced undesirable tastes and odors. The reservoir was removed from service and customers supplied with water from other utilities. Relocation of a pipeline was facilitated and consumers were not inconvenienced during a 1 week shutdown in 1971, during which water was supplied from other agencies. (Cassar-FRC)
W82-04090

PRACTICAL POWER-SAVING TECHNIQUES IN PINELLAS COUNTY,
Jones, Edmunds and Associates, Inc., Gainesville, FL.
R. C. Edmunds, W. M. Socha, and R. W. Patrick.
Journal of the American Water Works Association, vol 72, No 6, p 330-337, June, 1980. 6 Fig, 3 Tab, 1 Ref.

Descriptors: *Pumps, *Operating costs, Water treatment, Water distribution, *Water supply systems, *Pinellas County, *Florida, Energy, Optimization, Hydraulic machinery, Economic efficiency.

Techniques for reducing power costs in the Pinellas County, Florida, water system are described. The system serves 400,000 customers and has an average production of 42.9 mgd. General guidelines for this analysis were: (1) select pump combinations and variable speed drive pump speeds at individual pumping stations using the figures and tables developed for this purpose, (2) determine the most efficient combination of pumping stations for appropriate demands, (3) operate to maintain a minimum system pressure of 40 psi except during water shortages when it may be lower, (4) develop improved instrumentation for automatic monitoring of back flows and pressures. Computer programs were used to determine the optimum conditions for the Pinellas County system. Use of all the power reduction modifications would achieve a 3-7% savings in annual system pumping costs in addition to an already verified $120,000 per year savings. (Cassar-FRC)
W82-04092

PUMP SYSTEMS: WHAT PRICE INEFFICIENCY,
Burns and McDonnell, Kansas City, MO.
For primary bibliographic entry see Field 8C.
W82-04093

ORTHOKINETIC FLOCCULATION IN DEEP BED GRANULAR WATER FILTERS,
Colquhoun (Brian) and Partners, London (England).
I. R. Wilson, T. D. Lekkas, and G. T. J. Fox.
Journal of the American Water Works Association, Vol 72, No 6, p 356-366, June, 1980. 22 Fig, 5 Tab, 16 Ref.

Descriptors: *Filtration, *Flocculation, *Particle size, *Water treatment, Filters, Filter media, *Orthokinetic flocculation, Velocity gradient, Head loss, Alum, Turbidity, Capillarity.

Orthokinetic flocculation as affected by the velocity gradient within the filter pores was investigated in the laboratory using sand-anthracite dual media. Floc formation is controlled by the product of velocity gradient and residence time in the filter. The higher this value, the greater the number of primary particles collecting to form flocs. In reactions with the same velocity gradient-residence time product but different values of velocity gradient, the sizes of aggregate particles leaving the reactor are different. The larger the particle size, the more probability of its being retained on the filter. In one anomalous filter fun, removal efficiency increased with increases in velocity gradient and velocity gradient-residence time product, possibly because the shear strength limit was not reached until 6 hours after the beginning of the run, at which time filtrate turbidity started to increase. (Cassar-FRC)
W82-04094

MODIFICATIONS OF THE TENTATIVE STANDARD METHOD FOR IMPROVED VIRUS RECOVERY EFFICIENCY,
North Carolina Univ. at Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 5A.
W82-04095

UPGRADING WATER TREATMENT PLANTS: AN ALTERNATIVE TO NEW CONSTRUCTION,
Beard (Arthur) Inc., Chevy Chase, MD.
R. E. Forbes, G. L. Nickerson, H. E. Hudson Jr., and E. G. Wagner.
Journal of the American Water Works Association, Vol 72, No 5, p 254-261, May, 1980. 9 Fig, 2 Tab, 11 Ref.

Descriptors: *Turbidity, *Water quality, *Water treatment, Flocculation, Mixing, Sedimentation, Filtration, Backwash, Coagulation, Monitoring, Operating policies, Maintenance, Water treatment facilities.

Increasingly stringent water quality requirements, especially with respect to turbidity, may often be met by upgrading a water treatment plant at a fraction of the cost for new plant construction. Several processes are amenable to modifications. Rapid mix improvements usually involve changing the means and point of application of the chemical. In Rio de Janeiro 5-7 tons of alum were saved each day and water quality improved by moving the alum application point 8 meters upstream. In other plants mechanical mixers were replaced with concentric diffusers. Changes in the flocculation and sedimentation processes include elimination of short-circuiting by compartments and baffles and adding tube or plate settlers to sedimentation basins. In filtration, backwashing may be improved by changes in operation and maintenance procedures, changes of media, filtration rate control, and constant pressure operation. Better process control may be obtained with continuously recording turbidimeters, pilot filters to monitor chemical doses, and other methods. (Cassar-FRC)
W82-04098

AN EXPERIMENTAL APPROACH TO CORROSION CONTROL,
Philadelphia Suburban Water Co., Bryn Mawr, PA.
K. E. Shull.
Journal of the American Water Works Association, Vol 72, No 5, p 280-285, May, 1980. 10 Fig, 1 Tab, 15 Ref.

Descriptors: *Corrosion control, *Zinc compounds, *Water treatment, Monitoring, Materials testing, Water distribution, Water quality control, *Philadelphia, *Water supply systems, Copper, Iron, Pipes, Sodium hexametaphosphate.

Black iron pipe is used to monitor corrosion of water in the distribution system of the Philadelphia Suburban Water Company, which uses waters of differing hardness from four creeks, one river, deep wells, and a groundwater-fed reservoir. Recent corrosion tests indicated that 1 mg per liter bimetallic zinc phosphate allowed the least loss of head as compared with the plant control (pH 7.24) and water adjusted to pH 8.18 and 9.52. Addition of sodium bicarbonate at 20 to 80 mg per liter, producing pH levels of 7.48 to 7.91, gave higher head losses than the control. Changes in rate of flow showed that bimetallic phosphate inhibition was effective over a wide flow range. Studies of corrosion in copper pipes indicated that corrosion was higher during periods of zero flow, being accelerated by the presence of ferric ions. Corrosion rates were 1.9 mil per year in new copper tubing and 4.3 mil per year in older tubing. The water company introduced sodium hexametaphosphate in part of the system in 1948. Later the inhibitor was changed to bimetallic phosphate, which is currently in use at the cost of 15 cents per person per year. This chemical has prevented tuberculation of iron pipes, prevented formation of discolored water, and reduced staining of porcelain fixtures. (Cassar-FRC)
W82-04099

MONITORING AND CONTROLLING CORROSION BY POTABLE WATER,
Middlesex Water Co., Woodbridge, NJ.
E. D. Mullen, and J. A. Ritter.
Journal of the American Water Works Association, Vol 72, No 5, p 286-291, May, 1980. 9 Fig, 4 Tab, 7 Ref.

Descriptors: *Corrosion control, *Zinc compounds, *Hydrogen ion concentration, Pipes, Water quality control, Water distribution, Sodium hydroxide, Monitoring, Middlesex Water Company, *Woodbridge, *New Jersey, Water treatment, *Water supply systems.

Corrosion control was achieved at low cost by using mild steel test coupons for monitoring water quality in the Middlesex Water Company, Woodbridge, New Jersey, distribution system. Bench tests determined that sodium zinc glass phosphate reduced corrosion by 13% and zinc orthophosphate by 55% over the sodium hydroxide pH control. Corrosion rates increased with water temperatures. Zinc orthophosphate inhibition treatment without pH adjustment reduced corrosion rates by 54% while pH adjustment with caustic soda alone reduced corrosion rates by 13%. After zinc orthophosphate inhibitor addition equipment was installed in the water system at capital costs of $11,500, the corrosion rate goal of 3 mil per year or less was achieved. Acceptable corrosion rates for summer are 5 plus or minus 1 ml per year. Zinc dosages were 0.2 mg per liter in winter and 0.5 mg per liter in summer. (Cassar-FRC)
W82-04100

LABORATORY TECHNIQUE FOR MEASUREMENT OF PH FOR CORROSION CONTROL STUDIES AND WATER NOT IN EQUILIBRIUM WITH THE ATMOSPHERE,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5G.
W82-04101

MEASURING THE VELOCITY OF WATER IN A PADDLED FLOCCULATOR,
Visvesvaraya Regional Coll. of Engineering, Nagpur (India). Dept. of Civil Engineering.
A. G. Bhole.
Journal of the American Water Works Association, Vol 72, No 2, p 109-115, February, 1980. 11 Fig, 1 Tab, 17 Ref.

Descriptors: *Flocculation, *Velocity, Paddled flocculators, *Water treatment, *Measuring instruments, Water treatment facilities.

A simple, low cost apparatus for measuring the tangential velocity of water in a paddled flocculator consists of a stiff vertical needle supported by a horizontal rod, pivoted between two horizontal supports. A small sphere dragged through the water is displaced according to the local tangential velocity and can be brought back to its original vertical position by adding lead shot in a pan. This apparatus must be calibrated before use. Although this instrument is not as sensitive as other methods, it is inexpensive, easy to construct, and accurate enough for small fluctuations in velocity. The value of the drag coefficient used in Camp and Stein's equation (1943) was not constant, as was previously assumed, but varied from 0.94 to 1.8 for velocity gradients of 50 to 10 sec. (Cassar-FRC)
W82-04102

THE STATUS OF DIRECT FILTRATION.
Journal of the American Water Works Association, Vol 72, No 7, p 405-411, 1980.

Descriptors: *Surveys, *Water treatment, *Filtration, *Pretreatment of water, Data processing, Flocculation, Coagulation, Turbidity, Design criteria, Case studies, Pilot plants, Cost analysis, Water quality control.

Questionnaire results of a worldwide survey of pilot and operating plants using direct filtration during water treatment were compiled by the Direct Filtration Subcommittee of the American Water Works Association Filtration Committee. Historical data on raw water quality should be examined for two to three years prior to the construction of a direct filtration system. Plants which operated well reported the control of coagulation and flocculation processes. Polyelectrolytes are being increasingly used as coagulation flocculation aids, as filter aids and as sole coagulants. Most industrial plants used dual media filters, while some municipal plants used mixed media filters. Turbidity monitoring of filtered effluents gives an overview of filter performance. Points to consider in cost comparisons of direct filtration versus conventional treatment are considered. Research recommendations, data collection methods and techniques for analyzing questionnaire results are explained. Problems discussed on the questionnaire includes such topics as algae, raw and filtered water quality, pH, temperature, chemical usage, mixing energy, residual Al, Fe and Mn, color and special features of the filter. Some pilot plant work and case studies using direct filtration are considered. Design parameters for chemicals, mixing, flocculation, conditioning, organic reduction, filtration rates, virus and bacteria removal, and the treatment and disposal of waste streams are recommended. Some operational aspects of direct filtration such as monitoring water analysis and plant control are also discussed. (Geiger-FRC)
W82-04105

TREATMENT TECHNOLOGY TO MEET THE INTERIM PRIMARY DRINKING WATER REGULATIONS FOR INORGANICS: PART 5,
Environmental Protection Agency, Cincinnati, OH.
T. J. Sorg, and G. S. Logsdon.
Journal of the American Water Works Association, Vol 72, No 7, p 411-422, 1980. 11 Fig, 7 Tab, 43 Ref.

Descriptors: *Drinking water, *Separation techniques, *Water treatment, *Inorganic compounds, *Barium, *Radium radioisotopes, Reverse osmosis, Electrodialysis, Membrane processes, Ion exchange, Cation exchange, Anion exchange, Radioisotopes, Water quality management, Water quality standards, Economic aspects, Operating costs.

As part of the effort to meet the inorganic standards of the National Interim Drinking Water Regulations, methods for the removal of Ba and radionuclides, especially Ra, are described. The health effects of Ba and radicnuclides are briefly reviewed. Two-stage coagulation removes about 70% of Ba but is too expensive for practical purposes. Ion exchange and lime precipitation are two effective softening techniques for Ba removal. Powdered and activated carbon are ineffective for Ba removal, while electrodialysis and reverse osmosis show promise for Ba as well as hardness removal. Radium is best removed from drinking water by methods effective for Ca and Ba. The lime and lime-soda ash softening techniques of Ra removal show a pH dependence, with better removal at higher pH. Cation exchange resins will remove many cation radioisotopes, while anion exchange resins will remove anion radioisotopes. The major considerations in selecting a treatment method are the economics, which involve capital and operating costs and depend on the design and size of the facility. (Geiger-FRC)
W82-04106

ACTIVATED CARBON VERSUS RESIN ADSORPTION OF HUMIC SUBSTANCES,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
P. H. Boening, D. D. Beckmann, and V. L. Snoeyink.
Journal of the American Water Works Association, Vol 72, No 1, p 54-59, January, 1980. 7 Fig, 2 Tab, 19 Ref.

Descriptors: *Activated carbon, *Ion exchange, *Adsorption, Humic acids, *Water treatment, Fulvic acids, Organic acids, *Resins, *Comparison studies, Human substance removal.

Several commercially available synthetic resins and activated carbons were evaluated for their ability to remove humic substances that are trihalomethane precursors. A styrene-divinylbenzene strong base resin with quaternary ammonium groups (IRA-904) had excellent capacity for removing humic substances, and organic removal was not greatly affected by pH. Less effective were acrylic strong base resin with quaternary ammonium groups (IRA-458) and two weak base

resins (A-7 and ES-561) with amine groups. Resins with unacceptably low adsorption were styrene-divinylbenzene adsorbent resin (XAD-2), acrylic adsorbent resin (XAD-8), and carbonaceous resin (XE-340). The high activity bituminous carbons (1100 sq m per g surface area) and lignite carbon (650 sq m per g) removed humic acids very efficiently. The low activity bituminous carbons (900 sq m per g) had poor efficiency. Although the lignite carbon had a low surface area, its pore size distribution appeared well-suited for adsorbing high molecular weight materials. Removal efficiency was highly dependent on the source of humic material. Pilot plant tests with the specific water are suggested before choosing an adsorbent. (Cassar-FRC)
W82-04109

ALGAL CONCENTRATION AS A QUALITY PARAMETER OF FINISHED DRINKING WATERS IN AND AROUND PITTSBURG, PA,
Baker (Michael), Jr., Inc., Beaver, PA.
G. P. Kay, J. L. Sykora, and R. A. Burgess.
Journal of the American Water Works Association, Vol 72, No 3, p 170-176, March, 1980. 3 Fig, 6 Tab, 32 Ref.

Descriptors: *Algae, *Drinking water, *Water quality, *Water treatment, Pollutant identification, *Pittsburgh, Pennsylvania, Chlorella, Algicides, Reservoirs, Water storage, Eutrophication.

Algae were determined in drinking waters produced by Allegheny county, Pennsylvania, utilities during the warm months of 1976 and 1977. Mean algal levels were given as log cells per ml: 1.23 to 5.42 in the reservoirs and 0.96 to 3.26 in tap water. Dominant algae were Chlorella vulgaris. Finished watrs pumped from the five treatment plants to seven uncovered reservoirs are stored for 17 hours to 8 days. During this time algal populations tend to increase and are partially controlled by copper sulfate. Chlorine residuals are not enough to inhibit algal growth. Tap waters contained up to 1000 algal cells per ml, enough to produce visible turbidity. Species diversity in tap water was low. Bloom forming organisms were Chlorella vulgaris, ankistrodesmus falcatus, Scenedesmus quadricauda, Schizothrix calcicola, Achnanthes lanceolata, and Glenodinium quadridens, all hardy, eurytopic species. Algae in drinking water supplies may produce high levels of trihalomethanes on chlorination, violate turbidity standards, consume free chlorine, produce undesirable tastes and odors, and secrete endotoxins. (Cassar-FRC)
W82-04114

THE USE OF CHLORAMINES TO PREVENT TRIHALOMETHANE FORMATION,
Stahly Engineering and Associates, Kalispell, MT.
T. S. Norman, L. L. Harms, and R. W. Looyenga.
Journal of the American Water Works Association, Vol 72, No 3, p 176-180, March, 1980. 5 Fig, 4 Tab, 14 Ref.

Descriptors: *Chloramine, *Disinfection, *Chlorinated hydrocarbons, Chlorination, *Water treatment, Organic compounds, Trihalomethanes, *Huron, *South Dakota, Coliforms, Bacteria, Ammonium sulfate, Drinking water.

Trihalomethane levels in Huron, South Dakota, drinking water were reduced by substituting chloramine for chlorine in the disinfection step of the treatment process. Levels of bromodichloromethane and chloroform were reduced from highs of 116 and 309 micrograms per liter, respectively, to averages of 37 micrograms per liter, or 72-79%, depending on sampling site. Ammonium sulfate was used to ensure the chloramine residual. Coliforms were reduced an average of 93% by the lime softening process to levels of 0 to 104 per 100 ml. The remaining 7% were destroyed by the chloramine treatment. Water at the tap met coliform standards. Chloramine treated water had 52% lower plate count than chlorine-disinfected water. Average chemical costs were 2 cents per 1000 gal during 1978. (Cassar-FRC)
W82-04115

EXPERIENCE WITH DIRECT FILTRATION AT ONTARIO'S LAKE HURON TREATMENT PLANT,
Ontario Ministry of the Environment, Toronto.
P. D. Foley.
Journal of the American Water Works Association, Vol 72, No 3, p 162-164, March, 1980. 2 Fig, 7 Tab, 1 Ref.

Descriptors: *Filtration, *Turbidity, *Water treatment, *Lake Huron, *Ontario, Diatoms, Direct filtration, Polyelectrolytes, Alum, Flocculation, Aluminum.

The Lake Huron treatment plant, used by the Ontario Ministry of the Environment for evaluation of water treatment methods, was designed in 1964 to meet turbidity requirements of 5 JTU. Although the direct filtration plant has been able to meet the more recent 1 JTU standards, it would not be the treatment selected under today's water quality standards. Problems in the raw water include high diatom counts, turbidities up to 160 FTU, and high summer pH with resulting high aluminum levels. Modifications are being built to ensure the plant's ability to meet requirements. These include conversion of filter media to coarser coal fo 1.5 mm effective size and addition of nonionic polymers directly on top of the filters. When the plant modifications are finished, the capacity will be 72 mgd, up from 56 mgd. Tests are also underway to use ferric chloride to handle the residual aluminum problem. (Cassar-FRC)
W82-04116

CONDUCTING A REGULAR MAIN FLUSHING PROGRAM,
Massachusetts Dept. of Public Works, Tewksbury, MA.
P. L. Pattison.
Journal of the American Water Works Association, Vol 72, No 2, p 88-90, February, 1980.

Descriptors: *Water mains, *Flushing, *Maintenance, Water quality control, *Water treatment facilities, Water distribution, Corrosion, Sediments, Chlorination, Public relations.

Regular water main flushing should be part of every utility's annual maintenance program. Not only is water quality improved, but flushing can be combined with other maintenance procedures such as lubrication of hydrant caps and replacement of malfunctioning equipment. Annual or spring and fall flushing is recommended. Best public relations result from flushing during offpeak hours, 9 p.m. to 3 a.m., over a relatively short period, 8 weeks or less. Proper flushing includes systematic opening of hydrants to full discharge and continuing flushing until water appears clean in a white pan. In a 4 inch main, flow should exceed 10-12 liters per sec, and in an 8 inch main, 60-66 liters per sec. Chlorine doses should be adjusted to produce a free residual of 0.5 to 0.7 mg per liter before starting a flushing program. Mains being cleaned should always receive water from a recently flushed main. (Cassar-FRC)
W82-04118

RECENT DEVELOPMENTS IN DIRECT FILTRATION,
Montgomery (James M.), Inc., Pasadena, CA.
C. H. Tate, and R. R. Trussell.
Journal of the American Water Works Association, Vol 72, No 3, p 165-169, March, 1980. 11 Fig, 1 Tab, 15 Ref.

Descriptors: *Filtration, *Turbidity, *Color removal, *Water treatment, Direct filtration, Ozonation, Electron microscopy, Los Angeles, Owens River, Australia.

Three new developments in direct filtration technology are color removal from highly colored, low turbidity waters, ozone pretreatment, and evaluation of unit processes by electron microscopy. A direct filtration plant was designed for treatment of water up to 40 color units and average 2.5 TU in Australia. The system included ozonation, flash mixing, flocculation, filtration, and chlorination. The Los Angeles Department of Water and Power is currently evaluating cost effectiveness of preozonation followed by direct filtration for improving the water quality of Owens River water. Both scanning electron microscopy and transmission electron microscopy have been useful in the Los Angeles Owens River studies. Magnifications up to 200,000 fold allow distinguishing between inorganic and algal raw water particulates, observation of floc particles and the bacteria and other material trapped in the structure, as well as particle counting and size distribution determination. (Cassar-FRC)
W82-04122

DUAL DISTRIBUTION SYSTEMS ANALYSIS,
Weston (Roy F.), Inc., West Chester, PA.
A. K. Deb, and M. P. Evans.
Journal of the American Water Works Association, Vol 72, No 2, p 103-108, February, 1980. 6 Fig, 3 Ref.

Descriptors: *Water reuse, *Water supply systems, *Water distribution, *Water treatment, Dual distribution systems, Water quality, Municipal water, Water use, Model studies, Economic analysis, Drinking water, Activated carbon, Urban areas.

A model for technical and economic analysis of an urban water system having multiple sources and multiple distribution systems has been developed. This allows for up to three grades of water (potable, subpotable, and nonpotable) in both source and distribution system. The model can be used for designing new systems or modifying existing systems. It is applied to three cities of population sizes 20, 100, and 500 thousand using typical dual water systems. Output includes input data verification, costs and present worth of capital, operations and maintenance values, and total present worth of each system (both conventional and dual). In the first run the conventional water source is an unprotected river and water is treated with granular activated carbon and standard coagulation and filtration. In the corresponding dual system the potable source is good quality groundwater, and the subpotable source, treated river water. For a new system of this type the dual water supply costs are less than 85% of conventional supply costs. The dual system has no cost advantages over the conventional system at potable to total flow ratios above 0.25. The second system has only unprotected river water as a source for both conventional and dual systems. Both potable and subpotable water receive coagulation, sedimentation, filtration, and chlorination; the potable water has activated carbon treatment in addition. The conventional system is more economical at potable to total flow ratios above 0.2. These conclusions, drawn for the particular systems studied here, should not be generally applied to other systems and treatments. Dual supply systems are especially useful where recycled water is used and where raw water sources are of very poor quality. (Cassar-FRC)
W82-04123

WATER SUPPLY IN THE PARIS SUBURBS: CHANGING TREATMENT FOR CHANGING DEMANDS,
Compagnie General des Eaux, Paris (France).
P. Schulhof.
Journal of the American Water Works Association, Vol 72, No 8, p 428-434, 1980. 7 Fig, 2 Tab.

Descriptors: *Water demand, *Water supply development, Water resources development, Water use, *France, Metropolitan water management, *Paris, Water management, *Water treatment facilities.

Water treatment plants serving the area of the Paris suburbs have been plagued recently by increasing demands for water and decreasing raw water quality. Improvements gradually implemented at all stages of the treatment train have partly offset the situation, making the most of the facilities already in place. Since 1960 the rivers rapidly became loaded with organic materials and ammonia. To control the water quality, the water first had to be postchlorinated after the ozonation step. When the quantity of ammonia increased, it had to be eliminated at the beginning of treatment

through chlorine oxidation. Following extensive pilot plant research, plans were drawn up for new facilities which are now under construction. To meet the increasing demand for water, treated water from the Marne was to be used. No changes are being made in the water treatment for this added quantity of water, but a settling basin and a treated water reservoir will be built. Additional steps will be taken to contain industrial waste pollution, which causes some of the problems. Double filtration with sand and activated carbon for refining treated water is to be used, followed by a final chlorination step. Overall, flexibility is accorded high priority throughout the design and construction of the treatment plant, as future modifications will be needed to meet increasingly strict water quality standards. (Baker-FRC)
W82-04125

STUDIES OF ASBESTOS REMOVAL BY DIRECT FILTRATION OF A LAKE SUPERIOR WATER,
Minnesota Dept. of Water and Gas, Duluth.
D. L. Peterson, F. X. Schleppenbach, and T. M. Zaudtke.
Journal of the American Water Works Association, Vol 72, No 3, p 155-161, March, 1980. 6 Fig, 5 Tab, 8 Ref.

Descriptors: *Asbestos, Turbidity, *Filtration, *Water treatment, *Lake Superior, Asbestos removal, Duluth, Minnesota, Filter media, Alum, Direct filtration, Flocculation.

Removal of asbestos fibers from Lake Superior water has been investigated in pilot plant and full-scale studies at Duluth, Minnesota, since 1974. Water treatment process variables studied included effects of storm-produced high turbidity, chemicals and feed rates, filter media, and differences between conventional and direct filtration. Alum plus nonionic polymer proved effective for removing asbestiform fibers, which occur at levels of 100 million amphibole fibers per liter under most conditions and up to 1200 million fibers per liter during storms. Optimum pH is 7-7.2, and doses of chemicals depend on turbidity. Normal effluent turbidity is 0.04 NTU, and filters are backwashed at 0.05 NTU if an upward trend in turbidity is noted. The plant satisfactorily removed fibers from high turbidity water during storms. Particle counters were successful as a monitoring technique for fibers. Electron microscopy was too expensive for this purpose. There was little difference in effluent fiber levels from direct and conventional filtration, 0.05 and 0.03 million fibers per liter, respectively. Mixed media filters performed better than dual media filters, but effluent fiber counts were similiar. Alum sludge has been successfully dewatered by natural freezing. (Cassar-FRC)
W82-04127

DIRECT FILTRATION TREATMENT PLANTS: COSTS AND CAPABILITIES,
Environmental Protection Agency, Cincinnati, OH.
G. S. Logsdon, R. M. Clark, and C. H. Tate.
Journal of the American Water Works Association, Vol 72, No 3, p 134-147, March, 1980. 11 Fig, 6 Tab, 16 Ref.

Descriptors: *Construction costs, *Estimated costs, *Filtration, Design criteria, *Water treatment facilities, Turbidity, Costs, Capital costs, Direct filtration, Planning.

Cost estimates and actual costs of direct filtration treatment systems in seven locations are compared. Discrepancies may result from difference in types of facilities, design criteria, level of site beautification, phasing, special provisions for climate, supplier policies, contractors' workloads, differences in defining plant capacity, type of funding, and lack of sufficient data. Adjustments are suggested to bring the estimates and actual costs closer. Water quality produced by most direct filtration plants is satisfactory, meeting the 1 NTU limit. Although some raw water turbidities are very low, it is not desirable to omit the coagulation step, which removes Giardia cysts and asbestos fibers. (Cassar-FRC)
W82-04128

PLANT-SCALE COMPARISON OF DIRECT FILTRATION VERSUS CONVENTIONAL TREATMENT OF A LAKE ERIE WATER,
Pirnie (Malcolm), Inc., Paramus, NJ.
G. P. Westerhoff, A. F. Hess, and M. J. Barnes.
Journal of the American Water Works Association, Vol 72, No 3, p 148-155, March, 1980. 8 Fig, 6 Tab, 8 Ref.

Descriptors: *Filtration, *Turbidity, *Water treatment, Chlorinated hydrocarbons, Direct filtration, *Lake Erie, Sturgeon Point, New York, *Comparison studies.

Direct filtration was superior to conventional treatment of Lake Erie water in plant-scale tests at the Sturgeon Point plant near Buffalo, New York. The intake was split into 2 streams, each treated by a separate process. Direct filtration consistently produced high quality water at savings of $50,000 per year, not including savings in sludge handling costs. Filtered water with turbidities of 0.1-0.3 TU was produced by direct filtration of raw water with turbidities of 1 to 100 TU at filtration rates of 1.4 to 4 mm per sec. Although direct filtration had shorter filter runs than conventional treatment (18-61 hours vs. 59 hours), process control was easier. Direct filtration removed 52% of the trihalomethane precursors and conventional treatment, 35%. Although final trihalomethane concentrations were slightly higher in the direct filtration process because of longer precursor contact with chlorine, all levels were well below 100 micrograms per liter. (Cassar-FRC)
W82-04129

COMPUTER MODELING PROGRAMS: TOOLS FOR MODEL OPERATIONS,
Denver Water Dept.
For primary bibliographic entry see Field 6A.
W82-04130

THE COSTS OF COMPLIANCE: AN EPA ESTIMATE FOR ORGANICS CONTROL,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 6C.
W82-04132

INITIAL DEGRADATION OF EFFLUENT QUALITY DURING FILTRATION,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
A. Amirtharajah, and D. P. Wetstein.
Journal of the American Water Works Association, Vol 72, No 9, p 518-524, September, 1980. 12 Fig, 20 Ref.

Descriptors: *Filtration, *Effluents, *Wastewater treatment, *Water quality, Backwash, Filters, Evaluation.

This paper explores the basic causes of poor effluent quality in the initial stages of a filter run of a repeatedly used filter. The mechanism responsible for the poor effluent appears to involve an interaction between the backwash stage and the initial stages of filtration, during which a degradative phase is followed by an improving phase. The backwash water remnants in the system can be subdivided into three types: clean backwash water in the underdrains and connecting pipework from the backwash water supply system up to the bottom of the media; backwash water remnants within the pores of the media; and backwash water remaining above the filter media up to the level of the wash water gutter. The major sources of suspended solids and the material released during interparticle collisions of the media on closure of the backwash valve. Often the material released during the interparticle collisions does not cause a significant deterioration in effluent quality. A direct geometric progression relationship exists between the filtration rate and the highest peak of the initial effluent quality curve. These data indicate that the initial degradation could be modeled with a plug flow dispersion characteristic. The rate at which the backwash valve is shut down has an influence on the material released and on the first peak of initial degradation in the ensuing run. The initial degradation may have implications for the design and operation of filters needed to produce extremely high quality water, especially for the total elimination of minute quantities of toxic metals and viral or bacterial pathogens. (Baker-FRC)
W82-04134

CURBING THE DISTRIBUTION ENERGY APPETITE,
Black and Veatch, Kansas City, MO.
J. L. Patton, and M. B. Horsley.
Journal of the American Water Works Association, Vol 72, No 6, p 314-320, June, 1980. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Energy, *Electric power costs, *Pumping, *Water distribution, Costs, Pumping head, Static head, Pressure head, Water metering, Water conservation, Water storage.

Methods for reducing the use and cost of electricity in high-service pumping for potable water distribution are presented. It is expected that the largest price increases will be in the area of demand charge, a function of the electric utility's fixed costs, investment charges, and other expenses not included in the other two components of the rate schedule, energy charge and power factor charge. Energy cost reduction methods include: (1) reduction of service pressure to 35 m (50 psi) and installation of individual booster pumps for high rise buildings and fire fighting, (2) use of gravity feed storage to smooth pumping variations and reduce peak electrical demand, (3) reduction of peak electrical demand by use of engine-driven pumps, (4) improvements in operating efficiency of pumps, (5) power factor modifications such as changes in motor loading, changes in motor type, and use of capacitors, and (6) reduction of water volume pumped by decreasing pressure (reduces leakage and residential use), increasing the percentage of metered customers, and water conservation devices. (Cassar-FRC)
W82-04136

THE BED DEPTH SERVICE TIME DESIGN METHOD FOR DEEP BED FILTRATION,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Civil Engineering.
A. M. Saatci, and C. S. Oulman.
Journal of the American Water Works Association, Vol 72, No 9, p 524-528, 1980. 8 Fig, 2 Tab, 13 Ref.

Descriptors: *Filters, *Design criteria, Wastewater treatment, Industrial wastes, *Water treatment, Municipal wastes, Clarification, Deep bed filtration, Pilot plants.

A method is described for evaluating the coefficients needed in filter design so as to provide a rational basis for the design of a deep bed filter. Once they have been determined, these coefficients can be used along with estimates of head loss to evaluate the effects of flow rate, filter length, influent concentration and effluent suspended solids concentration on the length of a filter run. Pilot plant tests using filters of various lengths can be used to determine the coefficients, or they can also be determined, with a somewhat lower degree of accuracy, from the performance of a single existing filter. When considered together with estimates for the head loss based on these filter runs, the results of a design analysis employing the bed depth service time method can provide a rational basis for the design of a deep bed filter. (Baker-FRC)
W82-04143

AGGRESSIVE WATER: ASSESSING THE EXTENT OF THE PROBLEM,
Health Effects Research Lab., Cincinnati, OH.
J. R. Millette, A. F. Hammonds, M. F. Pasing, E. C. Hansen, and P. J. Clark.
Journal of the American Water Works Association, Vol 72, No 5, p 262-266, May, 1980. 7 Fig, 2 Tab, 10 Ref.

Descriptors: *Water distribution, *Corrosion, *Utilities, *Water quality, Aggressive water,

Public health, Langelier index, Ryznar index, Hydrogen ion concentration, Hardness, Alkalinity, Pollutant identification, Acidic water, *Corrosion potential.

Aggressiveness indexes were computed from 1300 water samples from 130 utilities in 35 areas serving about 40 million people. Of the representative utilities 16.5% had highly aggressive water; 52.0%, moderately aggressive water; and 31.5%, nonaggressive water. The Langelier index for estimating corrosion potential, more difficult to compute, gave similar results. According to the Ryznar index, a quality index based on the amount of calcium carbonate scale formed, 20% of U.S. utilities have very aggressive water. Aggressive water may affect public health by releasing metals or asbestos fibers from distribution system pipes and home plumbing. (Cassar-FRC)
W82-04144

AN EVALUATION OF ACTIVATED CARBON FOR DRINKING WATER TREATMENT: A NATIONAL ACADEMY OF SCIENCE REPORT,
Drexel Univ., Philadelphia. PA.
I. H. Suffet.
Journal of the American Water Works Association, Vol 72, No 1, p 41-50, January, 1980. 1 Fig, 8 Tab, 88 Ref.

Descriptors: *Activated carbon, *Adsorption, *Organic compounds, *Water treatment, Drinking water, Pollutant identification, Ion exchange, Microbiological studies, Public health.

The National Academy of Science subcommittee report on the use of activated carbon in drinking water treatment is summarized. The report is divided into 6 major categories: (1) adsorption efficiency of granular activated carbon with respect to organic compounds of health concern, effectiveness of pretreatment with powdered activated carbon in removal of organic compounds, and competitive adsorption of various trace organics on the carbon surface; (2) microbial activity including interaction of microorganisms with the adsorption process, effects of ozone or chlorine pretreatment on microbial activity, and attachment of microbial colonies on the granular activated carbon surface; (3) production of nonbiological substances by or within the carbon bed, for example, carbon fines or reaction products of disinfectants; (4) regeneration of granular activated carbon and leaching of toxic substances from carbon; (5) adsorption efficiency of other adsorbents such as ion exchange resins and polymers in removing humic substances and organic matter of health concern; and (6) analytical methods for monitoring adsorbent unit processes in water tretment. Although there are many gaps in knowledge of granular activated carbon in water treatment, it has been shown effective in removing trace organics. No known harmful health effects of its use have been demonstrated, but more research in this area is indicated. (Cassar-FRC)
W82-04146

A FLUORIDE OVERFEED INCIDENT AT HARBOR SPRINGS, MICHIGAN,
Michigan Dept. of Public Health, East Lansing.
For primary bibliographic entry see Field 5C.
W82-04147

RELIABILITY AND REDUNDANCY: DUAL PROTECTION FOR WATER TREATMENT PLANTS,
C. L. Hamann, and L. G. Suhr.
Journal of the American Water Works Association, Vol 72, No 4, p 182-186, April, 1980. 3 Fig, 1 Tab.

Descriptors: *Design criteria, *Flexibility, *Water treatment facilities, Reliability, Redundancy, Hydraulic equipment, Gravity flow, Disasters, Water supply, *Operating policies, Maintenance.

Reliability and redundancy are fundamental in the design of water treatment plants. Reliability relates to the inherent dependability of equipment or processes. Redundancy is the provision of standby equipment or processes to improve reliability. An equation relates these two factors. Reliability may be improved by adding reserve capacity, by having more than one way to perform a fuction, and by having flexibility. Reliability decreases if a unit process combines 2 or more process functions, if processes operate in parallel trains with no interconnections, and if only 1 or 2 units are available to perform a specific function. Gravity flow is very reliable and should be considered in plant location and design. A designer must also account for the reliability of the water supply, the components of the plant (valves, monitors, etc), electric power, chemical supplies, and operation and maintenance procedures. (Cassar-FRC)
W82-04148

REMOVAL OF ORGANICS BY REACTIVATED CARBON,
Missouri Water Resources Research Center, Columbia.
M. M. Ghosh, and G. R. Mueller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-204835, Price codes: A07 in paper copy, A01 in microfiche. Completion Report, June, 1981. 132 p, 29 Fig, 10 Tab, 47 Ref. A-115-MO(1), USDI-OWRT-14-34-0001-0127.

Descriptors: Adsorption, Competition, Bisolute systems, Column breakthrough, Equilibrium, *Drinking water, Potable water, *Organic carbon, *Trihalomethanes, Humic acids, Chloroform, Fulvic acids, Activated carbon.

Limited studies with regenerated carbons revealed that the change in adsorptive capacity of the carbons because of regeneration was insignificant. The major emphasis of the project was placed on the competitive adsorption of chloroform on granular activated carbon in the presence of humic acid. A lignite base carbon, ICI HD-4000, a product of the ICI Americas, Inc., was used for the entire study. The adsorptive capacity of the carbon for humic acid was quite low, only 0.68 mg TOC/g of carbon at a liquid phase concentration of 1 mg TOC/l. The humic acid molecule suffers from steric hindrance within the micropores of HD-4000, 50% of which with radii 100 A or larger while that of humic acid molecule is 50-80 A. This results in slow kinetics of adsorption. The mass transfer for humic acid is controlled primarily by film transfer. The adsorption of chloroform was one order of magnitude greater than that of humic acid, but still quite low; 5 mg CHCl3/g was adsorbed at a solute concentration of 300 micrograms/l. The film diffusion coefficient for chloroform was 1.25 x 1/1000 cm/sec, two orders of magnitude greater than that of humic acid. The overall mass transfer of chloroform seems to be controlled by intraparticle diffusion. From equilibrium tests in slurry reactor and continuous column studies, no competition between humic acid and chloroform was apparent. However, conceivably, in tall columns or where carbon is presaturated with humic acid, some competition may be observed.
W82-04159

WATERBORNE GIARDIASIS--AN OVERVIEW,
Williamsport Sanitary Authority, PA.
For primary bibliographic entry see Field 5C.
W82-04186

DUAL DISTRIBUTION SYSTEM SOLVES PELICAN BAY'S WATER SUPPLY PROBLEMS,
Post, Buckley, Schuh, and Jernigan, Inc., Fort Myers, FL.
R. R. Wright, and P. F. Blery.
Water/Engineering and Management, Vol 129, No 1, p 46-48, January, 1982. 2 Tab.

Descriptors: *Water supply, *Water resources development, *Water management, Water distribution, Water conveyance, *Pelican Bay, *Florida.

The first phase of a dual water distribution system was constructed in 1979 for the Pelican Bay Improvement District of the Florida coastal regions. Pelican Bay is a 2,100 acre planned luxury residential community situated on the Gulf coast just north of Naples. The community will contain 9,600 residential units as well as commercial, residential and conservation areas. Before a dual system can be economically justified, the following four conditions must be met: the raw water supply must usually be high in dissolved solids and chlorides and not treatable by conventional methods; the untreated or partially treated nonpotable water must be of adequate quality for irrigation purposes; a customer water use pattern must indicate a relatively substantial portion of total water usage represented by nonpotable applications; and the local development codes and ordinances are flexible enough to design pipeline sizes, pressures, and other parameters to match appropriate use. The key factors influencing the economic advantages of a dual system were the need to use expensive revrse osmosis treatment to produce potable water, and an irrigation water demand equivalent to about 50% or more of the total water consumption. After nearly two years of operation, the actual water quality of the potable water is essentially the same as the design work predicted. However, projected flows used for these initial years were too low. (Baker-FRC)
W82-04193

RENOVATION OF WATER MAINS AND SEWERS,
Newcastle and Gateshead Water Co. (England).
H. D. M. Speed, and M. J. Rouse.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 5, p 401-424, 1980. 2 Fig, 23 Ref.

Descriptors: Conduits, *Sewers, Repairing, *Maintenance, *Costs, Construction, *Water mains, Planning, Testing.

The problems associated with the deterioration of water mains and sewers are described, and the possibility of restoration to good condition so as to substantially extend life is discussed. Effects of deterioration include reduced carrying capacity, increased pumping friction head, water quality problems, reduced strength, and leakage and breaks. Before renovation of water mains is considered the following factors must be evaluated: cost, maintenance of service to customers, and availability of service space. Reclining could in some cases cost as little as 25% of replacement. Sewers can also be relined, or pointing, joint sealing, and grouting may be required. Speculative trials are recommended. The trials must be planned and carefully monitored. (Small-FRC)
W82-04237

5G. Water Quality Control

DISCUSSION: INFLUENCE OF WELL WATER QUALITY VARIABILITY ON SAMPLING DECISIONS AND MONITORING, BY HARRY I. NIGHTINGALE AND WILLIAM C. BIANCHI,
Geological Survey, Reston, VA.
L. F. Konikow.
Water Resources Bulletin, Vol 17, No 1, p 145-146, February, 1981. 2 Ref.

Descriptors: *Wells, *Well water, *Water quality, Water table wells, Aquifers, Aquifer testing, Water quality data, Sampling, Water sampling, Water analysis, Variability, Aquifer management, Groundwater management.

The connection between effective sampling of ground water for quality changes and effective groundwater management techniques is explored. Sampling programs should be designed so as to allow a meaningful description of the water quality status in the aquifer system being examined and provide a basis for inferring causes for noted changes in that quality. Random selection of samples is a logical choice for examining an aquifer about which little is known. However, once some information is gathered, sampling structures should be modified to recognize the existence of plumes or stratification in the population to be sampled. It must be remembered that a sampling program that is able to determine the mean and standard devi-

ation of a well water quality parameter in a given area may not be adequate for accurately mapping the spatial distribution of that same variable, for determining sources of chemicals, or for predicting future changes. (See abstract No. W80-02356 for subject paper).
W82-03779

DISCUSSION: WATER QUALITY TRAP EFFICIENCY OF STORM WATER MANAGEMENT BASINS, BY RICHARD H. MCCUEN,
Duke Univ., Durham, NC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-03784

DISCUSSION: A MULTIOBJECTIVE MODEL FOR REGIONAL WATER QUALITY MANAGEMENT, BY B. N. LOHANI AND PAKHORN ADULBHAN,
Pittsburgh, PA.
R. A. Chadderton.
Water Resources Bulletin, Vol 17, No 1, p 142-143, February, 1981. 7 Ref.

Descriptors: *Model studies, *Water quality management, Water quality control, Streams, Water quality standards, Regional analysis, Regional planning, *Waste load allocations.

This discussion presents a variety of models used in the United States to house frameworks for management of waste load allocations. Specific attention is given to a goal programming model which had been presented in another paper. This model considers dissolved oxygen stream standards and total treatment costs as two multiple goals to be met. Also discussed in depth are the two basic approaches outlined in the United States statutes for establishing levels of pollutant control. One level of control involves technologically established limitations, i.e., limitations imposed by technology. The second level of control approaches the situation from the view of what is and is not acceptable in water quality. (See Abstract No W79-00551 for subject paper) (Baker-FRC)
W82-03785

MULTI-CONSTITUENT SIMULATION AND OPTIMIZATION MODELS FOR WATER QUALITY MANAGEMENT,
Cornell Univ., Ithaca, NY.
R. J. Hughto.
PhD Thesis, May, 1981. 240 p, 44 Fig, 28 Tab, 102 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-19482.

Descriptors: *Water quality, Management, *Model studies, *Mathematical models, *River basins, Water pollution, Optimization, Simulation, Linear programming, River systems.

The objective of this research was to develop a multi-constituent water quality management model for river systems. The prime motivating factor for formulating such a model was to develop a tool that would make it possible to conduct water quality planning for river basins in a more comprehensive way than is possible using the standard BOD/DO models. The management model is an optimization model, which was formulated as a linear programming problem to make it more accessible and practical for use by those responsible for making water quality planning decisions. A simulation model also was developed that consists of the response equations for the constituents in the management model. In developing the multi-constituent model, many chemical and biological constituents of water quality were included. When Michaelis-Menten kinetics are used to describe the growth of the living constituents, the model response equations are nonlinear partial differential equations that had to be linearized and numerically approximated to fit into the linear programming problem format. The linearization is an iterative procedure, and the linearized response equations are numerically approximated using the Galerkin finite element method in space and a finite difference approximation in time. Two example problems were solved to demonstrate the application of the models developed. (Sinha-OEIS)
W82-03815

WATER QUALITY MANAGEMENT USING THE HAZARD ASSESSMENT APPROACH,
Colorado State Univ., Fort Collins, Dept. of Civil Engineering.
B. W. Newbry.
PhD Thesis, 1981. 572 p, 8 Fig, 1 Tab. 34 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No. GAX81-26443.

Descriptors: *Water quality control, *Water quality management, *Water quality criteria, *Hazards, Water pollution sources, Chlorination, Aquatic life, Environmental protection, United States.

At present, water quality management is based largely on 'worst case' contaminant criteria applied directly as water quality standards. Such criteria are generally developed from aquatic life toxicity tests conducted under controlled conditions in the laboratory. Worst case criteria reflect continuous exposure of aquatic organisms to the most toxic form or forms of the particular contaminant. For a number of reasons, water quality standards numerically equivalent to these criteria may be substantially more stringent than required to adequately protect desired beneficial uses of particular waterbodies. Further, it appears that cost for contaminant control measures required to reduce contaminant levels to less than the applicable criteria on a large scale throughout the U.S. would far exceed the funds available for contaminant control. The hazard assessment approach provides a systematic methodology for developing defensible water quality management strategies. Starting with worst case criteria as 'flags' to identify potential problem areas, the hazard assessment approach can be used to define the true nature of each potential problem. It provides technical justification for selection of a specific course of action for resource allocation for water quality programs. Hazard assessment uses aquatic toxicology, environmental chemistry, and other scientific information, together with sound engineering judgment, to estimate the probable effects of contaminants and contaminant sources on beneficial uses of waterbodies. A series of examples demonstrates the application of the methodology. The role of hazard assessment in the water quality management decision making process is discussed and techniques and concepts directly applicable are presented in detail. (Sinha-OEIS)
W82-03823

CONSTRUCTION OF CONTAINMENT FACILITY FOR DREDGED MATERIALS BEGINS,
P. A. Farragut.
World Dredging and Marine Construction, Vol 17, No 11, p 22-25, November, 1981. 4 Fig.

Descriptors: *Dredging, *Spoil disposal, Dikes, *Water pollution prevention, *Chesapeake Bay, *Baltimore Harbor, Maryland, Recreation facilities, Ocean disposal, Sediments.

Construction of a disposal site for dredged materials from Baltimore ship channels was started September 1981 near Hart and Miller Islands in the Chesapeake Bay. The 1,140 acre dike enclosure will contain 52 million cu yards of dredged material. The 1-mile wide, 2-miles long sand dike will be 20 ft wide at the top and 250 ft at the base. Stone riprap will be placed on the bayside portion. The dredged material and water will be pumped into the enclosure and the sediment allowed to settle. Water discharged into the bay will be monitored to assure that it meets water quality standards. The containment area will be available for recreation at all stages of filling. It is expected that aquatic and terrestrial habitats will provide opportunities for wildlife observation and fishing. A bathing beach will be available immediately. (Cassar-FRC)
W82-03839

RISK ANALYSIS IN THE PLANNING, DESIGN AND OPERATIONAL CONTROL OF WATER POLLUTION PREVENTION SCHEMES- A PERSPECTIVE,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
J. P. Lumbers, and P. W. Jowitt.
Water Science and Technology, Vol 13, No 8, p 27-34, 1981. 1 Fig, 5 Ref.

Descriptors: *Water pollution prevention, *Economic aspects, *Water quality management, *Risks, Water pollution control, Water pollution treatment, Investment, Developing countries, Industrial wastes, Public health, Drinking water, Future planning, Decision making.

Some considerations involved in the successful planning, design and operation of water pollution prevention schemes are discussed, with special focus on factors affecting drinking water quality in developing and industrialized countries. Pollution schemes which seek to reduce primary risks (direct effects on human health) may have difficulty in defining and assessing such risks and their casual mechanisms. Secondary risks caused by institutional failure or gross technical failure may represent further economic loss and other sources of uncertainty. In order for the International Drinking Water Supply and Sanitation Decade to address primary risk problems in developing nations, researchers must identify and quantify the risks and assess their probability of occurrence and the public awareness of them. In industrialized nations, river quality management is moving toward the adoption of probabilistic water quality standards. Although risk assessment is still an imprecise operation, a subjective evaluation of uncertainty and risk is still needed in decision making and future planning. The resolution of a water pollution prevention scheme depends on the formation of a balance between investment, acceptable reductions in primary risks and a tolerable amount of secondary risks. (Geiger-FRC)
W82-03857

WATER QUALITY MONITORING,
Minor Irrigation Dept., Lucknow (India).
A. C. Chatuvedi.
Water Science and Technology, Vol 13, No 8, p 1-6, 1981.

Descriptors: *Water quality management, *Monitoring, *Water pollution control, *Developing countries, Water quality control, Water pollution effects, Water pollution prevention, Watershed management, Water resources development, Environmental quality, Land use, Drinking water, *India.

An overview of the water quality situation in India is given, with special focus on recommendations for better quality management in this developing country. The groundwaters of the alluvial plains of Northern India were found to contain excess fluoride, chloride, iron and manganese, and high salinity in some areas. Other objectionable water contaminants were bicarbonates, hydroxides, nitrates and sulfates. Certain cations present in waters receiving industrial wastes were found harmful to crops, fish life, and the quality of drinking water. Other Indian water supplies suffer from increased sediment loads, fertilizer and pesticidal contaminants and thermal pollution. Besides collaboration with the United Nations and other international agencies to aid in water quality planning, the implementation of an environmental master plan is recommended in India to preserve environmental quality through land use controls. Some priority areas for development in the 1980's include the disposal of pollutants, sewer overflow control, strip mining modifications, design modeling, cost analyses, and watershed management. ((Geiger-FRC)
W82-03897

MANAGEMENT MODEL FOR CONTROLLING NITRATE CONTAMINATION IN THE NEW JERSEY PINE BARRENS AQUIFER,
Princeton Univ., NJ. Dept. of Civil Engineering.
G. J. Moosburner, and E. F. Wood.
Water Resources Bulletin, Vol 16, No 6, p 971-978, December, 1980. 4 Fig, 2 Tab, 17 Ref.

Descriptors: *Nitrates, Land use, Population density, *Model studies, Planning, *Water pollution

control, Water management, Management, *Pine Barrens, *New Jersey, Jackson Township, Hydrologic models, Regional planning, Water quality control, Septic tanks, Groundwater pollution, Solute transport.

A simulation/optimization approach of management modeling is used to establish land use zoning patterns to minimize the impact on water quality in rapidly developing Jackson Township in the Pine Barrens, New Jersey. Land use is predominantly suburban and rural residential with little agricultural or industrial development. Nitrates from septic tanks are the primary source of pollution. Other pollution sources in order of importance are sanitary landfill leachates, salt water intrusion, mine drainage, and accidental leaks and spills. The model consists of a simulation model for nitrate transport from septic tank systems and a multiobjective goal programming optimization model to determine population density restrictions. Model results indicated that population growth must be limited to 8 persons per sector or less at 7 of the 17 land use sectors to maintain a water quality goal of 9 mg per liter nitrates. (Cassar-FRC)
W82-03913

INTEGRATED PLANNING OF RURAL WATER SUPPLY AND SANITATION,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
E. S. Degoma, C. Polprasert, and B. N. Lohani.
Water Resources Bulletin, Vol 16, No 3, p 408-413, June, 1980. 7 Fig, 1 Tab, 11 Ref.

Descriptors: *Public health, *Sanitation, *Rural areas, Water treatment, Water quality control, *Developing countries, Coliforms, Water supply, Domestic water, Bacteria, Human diseases, Waste disposal.

Waterborne disease control must be considered in the context of a multiobjective Sanitation Package including a water supply subsystem, excreta and waste disposal subsystems, and man's sanitary habits. A Systems Dynamic model, using DYNAMO II Language, is presented to help in sanitation systems planning. This is based on daily life and activities of villagers in central Thailand, but may be applied to similar rural areas. Five combinations of different degrees of water treatment, excreta and waste disposal, and hygiene are compared, and the coliform densities for water source, on-site stored water, and household stored water are given. In addition, the coliform take-in rates through food and water are given. Coliform intakes (MPN per person per day) were as follows: (1) 53-730, no water treatment, poor waste disposal, poor hygiene; (2) 45-53, slow sand filtration water treatment, poor waste disposal, poor hygiene; (3) 43-210, no water treatment, improved waste disposal, poor hygiene; (4) 34-43, slow sand filtration water treatment, improved waste disposal, poor hygiene; and (5) 0-0.04, slow sand filtration water treatment, improved waste disposal, improved hygiene. Improvement of one subsystem without concurrent improvements in the other two subsystems did not reduce coliforms to satisfactory levels. (Cassar-FRC)
W82-03916

INPUT/OUTPUT MODELS AS DECISION AIDS FOR LAKE RESTORATION,
Maine Univ. at Orono. Land and Water Resources Center.
P. D. Uttormark, and M. L. Hutchins.
Water Resources Bulletin, Vol 16, No 3, p 494-500, June, 1980. 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Lake restoration, *Trophic level, *Nutrients, Water quality control, Input output analysis, *Model studies, Mathematical models, Phosphorus, Decision making.

Three input/output models were evaluated as guides for lake restoration. Models by Dillon and Rigler (1974) and Vollenweider (1975) correctly predicted the trophic state of 70% of the 25 study lakes from reductions in nutrient fluxes. The Vollenweider (1976) model was 82% accurate. Four lakes were not accurately described by any of the models. These simple models require minimal amounts of data and may be useful for screening purposes or preliminary design. (Cassar-FRC)
W82-03924

SEALING OF LAGOONS AND PONDS: PROPOSED QUALITY REQUIREMENTS FOR SOIL LINERS,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
T. B. Edil, and P. P. Didier.
In: Fourth Annual Madison Conference of Applied Research & Practice on Municipal & Industrial Waste, September 28-30, 1981. p 412-416, 1981. Department of Engineering & Applied Science, University of Wisconsin--Extension, Madison, WI.

Descriptors: Standards, *Bentonite, *Clays, *Lagoons, *Ponds, *Industrial wastes, *Wastewater lagoons, Industrial wastewater, Guidelines, State jurisdiction, Specifications, Sludge lagoons, Permeability coefficient, Sealants, Soil types.

The Wisconsin Department of Natural Resources is currently reviewing performance criteria and material requirements for soil-bentonite or clay blanket seals for use as natural and flexible liners in industrial wastewater lagoons and ponds. The concepts proposed, based on two performance criteria, include material requirements and protective cover for soil-bentonite seals, recommended procedures for mixing soil with bentonite, recommendations for 'clay' blanker liners, construction quality control, and monitoring. To achieve an adequate seal in systems using soil-bentonite mixtures, clay or other seal materials, the two related criteria must be satisfied individually: (1) the percolation rate of lagoon or pond water specified shall not exceed 500 gallons per day per acre, and (2) the coefficient of permeability in centimeters per second specified in the seal shall not exceed 10(-7) with a minimum seal thickness of 12 inches and 5x10(-8) with a minimum seal thickness of six inches. In no case shall seal thickness be less than six inches. Other recommendations for soil-bentonite liners are: (1) a minimum bentonite content of 5 percent by dry weight and at least 30 percent of plastic fines in the soil mixed; (2) a protective soil layer at least four inches thick over the liner, consisting of a soil material containing at least 50 percent fines; and (3) use of granular bentonite should be avoided when mixing soil with bentonite. Similar technical recommendations for clay liners are provided. Operation and maintenance of liners should be monitored by visual inspection, and wells should be monitored for groundwater effects. (Garrison-Omniplan)
W82-03941

INVENTORY OF SURFACE WATER RESOURCES OF THE STILLWATER CREEK WATERSHED AND AN INVESTIGATION INTO THE EFFECT OF LAND USE ON WATER QUALITY,
Oklahoma State Univ., Stillwater. Center for Applications of Remote Sensing.
For primary bibliographic entry see Field 7B.
W82-03948

GROUND WATER PROTECTION BY RECHARGE ZONE MANAGEMENT: INSTITUTIONAL ARRANGEMENTS,
JBF Scientific Corp., Wilmington, MA.
N. S. Shifrin, and M. Nolan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-197948, Price codes: A04 in paper copy, A01 in microfiche. Report submitted to Office of Water Research and Technology, August 20, 1981. 42 p, 3 Fig, 6 Tab, 46 Ref, Append. OWRT-C-00125-U(0495)(1), 14-34-0001-0495.

Descriptors: *Groundwater management, *Groundwater recharge, *Water quality control, Reviews, Waste management, Case studies, Recharge zone management.

The control of ground water quality by proper management of critical recharge zones was examined. A review of the important technical features of ground water and its contamination provided a foundation for a discussion of the needs, issues, existing legislation, and possible institutions for protecting this valuable resource. Three institutional levels of management were considered: local, regional, and state. The applicability of these approaches was analyzed both for the nation in general and for three specific case study areas in Virginia. This study concluded that a state-oriented approach to recharge zone protection has more advantages than the two alternatives. This conclusion applied both to the specific case studies and in general. Additionally, active municipal level participation must be solicited by the states. This is because land use planning by zoning controls offers one of the strongest existing mechanisms for recharge zone protection. Recharge zone protection essentially involves the management of wastes so as to prevent their entry into ground water. Hence, state pollution control agencies, with their existing responsibilities and technical capabilities for waste-management, offer a logical institutional arrangement for recharge zone protection. Special cases should be anticipated, however, where a regional approach may better address regionally unique problems. Where this is required, a state-oriented approach could still be used if it was able to establish regional ground water management areas or a regional approach could be instituted using existing 208 Agencies.
W82-03951

CONSIDERATIONS IN CHOOSING THE APPROPRIATE MIX OF URBAN AND AGRICULTURAL NONPOINT POLLUTION CONTROL,
Tennessee Univ., Knoxville. Dept. of Agricultural Economics and Rural Sociology.
W. M. Park, and L. A. Shabman.
Water Resources Bulletin, Vol 17, No 6, p 1023-1028, December, 1981. 1 Tab, 19 Ref.

Descriptors: *Nonpoint pollution sources, *Agriculture, *Urban areas, *Water pollution control, Planning, Water quality control, *Cost analysis, Urban runoff, Agricultural runoff.

Criteria have been developed to determine a best management practices strategy mix for controlling nonpoint source pollution from urban and agricultural areas. These criteria are: (1) cost effectiveness of the best management practices, (2) costs of information and administration, (3) flexibility, which allows for cost-effective changes in control measures in case of unforeseen developments, (4) direct and indirect associated effects such as esthetic benefits, and (5) acceptability to persons directly involved, such as farmers and local governments responsible for implementing the pollution control measures. Costs for agricultural pollution control generally are borne by a few persons, whereas urban pollution control measures are funded by taxes spread among many people. In addition farmers cannot pass their higher costs on to their customers because farm prices are competitive. Therefore, urban pollution control measures will probably be favored unless subsidies are given to farmers for adopting best management practices. (Cassar-FRC)
W82-04063

INTENSIVE SURVEY OF THE SABINE-NECHES CANAL - SEGMENT 0703,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 5A.
W82-04078

INTENSIVE SURVEY OF ARMAND BAYOU,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 5A.
W82-04079

INTENSIVE SURVEY OF HUNTING BAYOU,
Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 5A.
W82-04080

RELATIONSHIPS BETWEEN ODOR AND COMMONLY MEASURED WATER QUALITY

CHARACTERISTICS IN SURFACE WATER SUPPLIES,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5B.
W82-04081

LABORATORY TECHNIQUE FOR MEASUREMENT OF PH FOR CORROSION CONTROL STUDIES AND WATER NOT IN EQUILIBRIUM WITH THE ATMOSPHERE,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
M. R. Schock, W. Mueller, and R. W. Buelow.
Journal of the American Water Works Association, Vol 72, No 5, p 304-306, May, 1980.

Descriptors: *Hydrogen ion concentration, *Corrosion control, *Water distribution, Pipes, Water analysis, Carbon dioxide, Alkalinity, *Water quality control, Chemical reactions.

Improvements in pH measurements for water in distribution systems reduce errors caused by atmospheric carbon dioxide, precipitation and aging of materials such as calcium carbonate or ferric oxyhydroxide, organism growth and respiration, and reactions with the container. The water sample is maintained with no air space under sealed conditions after collection and during pH measurements. Other precautions are having the buffer and samples at the same temperature, storage of buffers in closed containers, and a constant and not too high stirring rate. The pH of a sample with 3.27 mg per liter of calcium carbonate alkalinity was determined by the suggested method and varied by only + or - 0.002 units over 30 min. When the pH measurements were done with the sample open to the atmosphere, pH increased by 0.8 units over 30 min. This method is not necessary for samples already in equilibrium with the atmosphere or with a very high buffer capacity. (Cassar-FRC)
W82-04101

RESERVOIR IMPROVEMENTS AS A KEY TO SOURCE QUALITY CONTROL,
Bridgeport Hydraulic Co., CT.
A. R. Castorina.
Journal of the American Water Works Association, Vol 72, No 1, p 27-30, January, 1980. 1 Fig, 3 Ref.

Descriptors: *Reservoirs, *Watershed management, *Dikes, *Water quality control, *Connecticut, Aeration, Diversion ditches, Retention time, Watershed protection, Wildlife, Trap Falls Reservoir, Settling basins, Crustaceans.

Protection and improvement of raw water supplies can be accomplished by several simple, inexpensive, permanent measures. Problems and their solutions in two Connecticut reservoir systems are described. The Seymour system had poor water quality in summer at two of the four reservoirs and high coliform counts in the terminal reservoir after rainstorms. These problems were solved by installing a $6000 aeration system in the stratified reservoir and constructing a diversion ditch for rain runoff to increase detention time and reduce coliform counts. Problems at the Trap Falls Reservoir included unrestricted construction in the small watershed, with resultant deterioration of water quality. There was also a large flock of Canada geese causing coliform contamination. Tests revealed that water was short-circuiting in the system, with a detention time of less than a week rather than several months as originally thought. Existing islands were connected with earth dikes, and detention time was increased enough to improve color, turbidity, and uniformity of quality. These projects cost $200,000. (Cassar-FRC)
W82-04145

EFFICIENTLY REDUCING NONPOINT PHOSPHORUS LOADS TO LAKES AND RESERVOIRS,
Northeastern Forest Experiment Station, Broomall, PA.
For primary bibliographic entry see Field 5B.
W82-04154

BACTERIAL CONTROL OF AQUATIC ALGAL POPULATIONS--PHASE II,
Medical College of Ohio at Toledo. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-04163

USE OF HYDROXYLPROPYLCELLULOSE TO DECREASE WASTAGE OF DISPERSE DYES IN THE CONTINUOUS DYEING OF POLYESTER,
Auburn Univ., AL.
W. S. Perkins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-202086, Price codes: A02 in paper copy, A01 in microfiche. Report, October, 1981. 10 p, 2 Fig, 4 Tab, 9 Ref. A-078-ALA(1), OWRT-14-34-0001-1101.

Descriptors: *Antimigrants, Polymers, Color, Dyes, *Dye industry wastes, Dye dispersion, Migration, Polyester.

A new concept for control of particulate migration of disperse dyes was tested in utilizing hydroxypropylcellulose as an antimigrant. Results indicated that polymers which precipitate upon heating of the fabric during the drying process are effective antimigrants. Futhermore, the yield of color using the experimental polymers was higher than for conventional antimigrants. Improved color yield results in lower dye cost and less color in a mill's effluent. The results of these lab tests indicate that the commercial scale tests should be made using these experimental antimigrants.
W82-04164

OPTIMAL CONTROL OF RESERVOIR DISCHARGE QUALITY THROUGH SELECTIVE WITHDRAWAL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
D. G. Fontane, and J. W. Labadie.
Water Resources Research, Vol 17, No 6, p 1594-1604, December, 1981. 10 Fig, 14 Ref.

Descriptors: *Reservoir releases, *Water temperature, Thermal stratification, Reservoir management, *Reservoir operation, Planning, Optimization, Temperature, *Water quality control, Downstream, Stratification, Model studies, Operating policies, Dynamic programming.

Methods developed for design of reservoir withdrawal structures have been used to determine optimum operating policies to meet downstream water temperature goals. Large reservoirs can be satisfactorily operated to achieve the desired downstream temperatures by downstream monitoring and release of water of the appripriate temperature. Smaller reservoirs without this capacity may severely violate temperature objectives, especially toward the end of the stratification cycle when the cold water supply is depleted. This paper presents a procedure to smooth out temperature changes over the season by anticipating future critical temperature conditions. A one-dimensional reservoir thermal simulation model (WESTEX) is used to simulate the thermal stratification cycle of a reservoir. This model is interfaced with objective-space dynamic programming, a new method of formulating dynamic programming, to develop the optimum operation for each decision period. An objective function related to release temperature deviations from desired target levels is minimized over a portion of the stratification cycle. The procedure, using a generalized one-dimensional dynamic programming code (CSUDP) as the second model, was applied to a reservoir in northwestern Pennsylvania. Deviations of the release temperatures from the target temperatures were 2 to 3 degrees C using the combined model. Using WESTEX alone release temperatures did not deviate from target temperatures for the first 60 days, but the temperature difference rapidly increased to 6 degrees C by the end of the 100-day season. (Cassar-FRC)
W82-04204

NUMERICAL MANAGEMENT MODELS OF GROUNDWATER POLLUTION,
Stanford Univ., CA.
For primary bibliographic entry see Field 5B.
W82-04211

THE WISCONSIN SOIL AND WATER CONSERVATION DISTRICT AS AN INSTITUTION TO UNDERTAKE SUBWATERSHED PLANNING TO CONTROL NON-POINT SOURCE WATER POLLUTION,
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 6A.
W82-04212

LAKE LEVEL DRAWDOWN AS A MACROPHYTE CONTROL TECHNIQUE,
Kent State Univ., Kent, OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 4A.
W82-04235

EUTROPHICATION MEASURES FOR SMALL LAKE WATER QUALITY MANAGEMENT,
De Paul Univ., Chicago, IL. Dept. of Economics.
For primary bibliographic entry see Field 2H.
W82-04243

EFFECTIVENESS OF DUPONT TYPAR SHEETING IN CONTROLLING MACROPHYTE REGROWTH AFTER OVERWINTER DRAWDOWN,
Kent State Univ., OH. Dept. of Biological Sciences.
G. D. Cooke, and M. E. Gorman.
Water Resources Bulletin, Vol 16, No 2, p 353-355, April, 1980. 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Drawdown, *Macrophytes, Sediment, Sediment covering, Aquatic plants, Lakes, Ponds, Reservoirs, Recreation, *Water quality control, Algae control, Plastic film, Aquatic weed control, *Polypropylene sheeting.

The effectiveness of a finely porous compound, DuPont 'Typar' spun-black polypropylene sheeting, was investigated for controlling the regrowth of aquatic macrophytes from lake sediments which had been exposed and frozen by an overwinter drawdown. This sheeting was believed superior to other polyethylenes because of its strength and its complete permeability to gases and water. The site of the study was Country Lake, Portage County, Ohio. The lake was built in 1958 and receives water primarily from storm runoff and groundwater. Country Lake is shallow through most of its area, and exhibits a dimictic thermal history only in the deep basin. About 50% of the lake area is covered with rooted macrophytes from late April through mid-October, curtailing fishing and boating, which are the principal uses of the lake. The DuPont sheeting material effectively controlled the regrowth of macrophytes in the summer of 1978. Only Najas flexilis and macroalgae were found in the treatment area. In contrast, the parallel transect had a macrophyte biomass at least 100X that of the sheeted area. Fish spawned in the weed covered areas but appeared to school in the clear open water created by the sheeting. At no time did the sheeting exhibit ballooning or lift-off from the sediment. (Baker-FRC)
W82-04246

WATER QUALITY TRAP EFFICIENCY OF STORM WATER MANAGEMENT BASINS,
Maryland Univ., College Park. Dept. of Civil Engineering.
R. H. McCuen.
Water Resources Bulletin, Vol 16, No 1, p 15-21, February, 1980. 4 Fig, 7 Tab, 11 Ref.

Descriptors: *Water quality, *Storm water, Sedimentation, Nonpoint pollution sources, Pollution load, Detention reservoirs, *Water pollution prevention, Storm water management, Watersheds, *Mongomery County, Maryland.

Levels of pollutants were examined in both inflow to and outflow from a storm water management basin in Montgomery County, Maryland, that is

located just below a suburban watershed draining both commercial and residential land use areas. Trap efficiencies were computed for eleven water quality parameters. The storm water management basin, which is frequently used to control increases in discharge rates, can also be used to reduce the level of pollutants in inflow to receiving streams. This particular detention basin was able to trap as much as 98% of the pollutant in the inflow. Of the 11 water quality parameters studied, most showed reductions of at least 60%, depending on storm characteristics. The fact that storm water management can be an effective means for controlling nonpoint source pollution is especially significant because many state and local governments require detention storage for the control of both peak discharge and sediment in urbanizing areas. However, the design of detention basins is different for flow control than it would be for pollution control, and therefore research on the multipurpose design of detention facilities for both flow and quality control is needed. An advantage of controlling nonpoint source pollution at the local level is that water quality in both rivers and small streams should improve, whereas regional control measures may not result in improvement of the water quality of small streams. (Baker-FRC)
W82-04248

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

DISCUSSION: A MULTIOBJECTIVE MODEL FOR REGIONAL WATER QUALITY MANAGEMENT, BY B. N. LOHANI AND PAKHORN ADULBHAN,
Pittsburgh, PA.
For primary bibliographic entry see Field 5G.
W82-03785

MULTI-ATTRIBUTE DECISION ANALYSIS FOR THE PROTECTION OF GROUNDWATER RESOURCES,
Texas Univ. at San Antonio. Div. of Environmental Studies.
C. S. Shih, and J. W. Ingram.
Journal of Hydrology, Vol 51, No 1-4, p 265-275, May, 1981. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Management planning, *Decision making, Municipal water, Water pollution prevention, Multiobjective planning, Groundwater reservoirs, Land development, Aquifer management, *San Antonio, Texas, *Groundwater management, Case studies.

The case of San Antonio, Texas, is used to demonstrate the use of decision analysis, coupled with multi-attribute utility assessments, as a management tool for situations involving a complex set of alternatives for a particular set of objectives. The problem facing the City of San Antonio is how to protect the Edwards underground aquifer, its sole water source, from the threat of pollution resulting from urban development over the aquifer recharge zone. This decision problem has been structured as a decision analysis model in an effort to provide local decision-makers with a highly objective and easily-documented means of deciding among alternative management policies. Multi-attribute utility functions were used as the measure of effectiveness for the various alternatives. A series of cyclic opinion surveys were used to gather the necessary judgmental information from a group of local water-resource decision-makers. Sensitivity analysis was conducted to illustrate the degree to which the solution of the problem was dependent upon the identified uncertain events. This study demonstrates that decision analysis and multi-attribute utility theory can greatly simplify complex water-resource management decision problems by helping decision makers to study the complicating details of the decision problem in a framework of systematic analysis. In situations in which decision-makers are reluctant to explicitly state their judgments, sensitivity analysis can provide a basis for eliminating some of the original alternatives and give a clearer picture of the ranges over which the remaining options would be preferred. (Carroll-FRC)
W82-03805

RESERVOIR SEDIMENTATION MODELING,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W82-03813

A MODEL FOR SOLVING MULTIPERIOD MULTIRESERVOIR WATER RESOURCES PROBLEMS WITH STOCHASTIC INFLOWS,
Texas Univ. at Austin.
D. D. Cochard.
PhD Thesis, May 1981. 285 p, 39 Fig, 16 Tab, 109 Ref, 3 Append, University Microfilms International, Ann Arbor, MI; Order No. GAX81-19275.

Descriptors: *Model studies, *Water resources development, *Stochastic progress, Reservoirs, Mathematical studies, Regression analysis, Value, Dynamic programming, *Multipurpose reservoirs, Texas, Stochastic inflows.

The model developed solves the multiperiod multireservoir water resources problem with stochastic inflows. Of unique importance is the development of a generalized network model which solves nonlinear nonseparable quadratic problems. Quadratic functions are used to measure the value of water to the system. The nonseparable form stems from the realization that interaction exists between the benefits to be gained from a multireservoir system. Historically this interactive nature has been ignored due to the computational difficulty of measuring and solving such relationships. Also developed is a stochastic dynamic programming approach which utilizes the results of the network optimization as data for a least squares regression analysis. A quadratic function is fit to this data and is used to represent the future value of water to the system for the next period in the dynamic programming approach. This functional representation of the future value of water replaces the standard discrete matrix representation of dynamic programming and greatly reduces the dimensionality problems associated with the dynamic programming approach. In the end, this work represents a rare combination of generalized-nonlinear network flow programming, stochastic dynamic programming and regression analysis. Example problems are included along with an application to a four reservoir model of the Guadalupe River Basin in Texas. (Sinha-OEIS).
W82-03830

RECREATIONAL ENHANCEMENT OF HIGH COUNTRY WATER SUPPLY RESERVOIRS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. W. Labadie, J. M. Shafer, and R. Aukerman.
Water Resources Bulletin, Vol 16, No 3, p 477-485, June, 1980. 4 Fig, 2 Tab, 5 Ref.

Descriptors: *Water management, *Reservoir operation, *Recreation, *Cache la Poudre River, *Colorado, River basins, Optimization, Model studies, Simulation analysis, Planning.

With proper management many high country reservoirs can be opened to the public for recreation. A decision model is presented to identify the factors necessary to the selection, planning, and management of resources reservoirs for recreation. This includes determination of users needs, comparison of user needs with existing reservoirs in the area, evaluation of environmental impact of opening reservoirs to recreation, and evaluation of the physical and legal feasibility of maintaining water levels suitable for recreation. The model is applied to the Cache la Poudre River basin, Colorado. Data needed are physical characteristics of the system, ideal monthly operational criteria for reservoirs, monthly unregulated flows, monthly demands, and monthly net evaporation rates. The simulation showed a management scheme which would hold water in the high mountain reservoirs during the peak recreation season without damaging downstream water users. (Cassar-FRC)
W82-03923

ASSESSMENT OF HIGH HEAT-TRANSFER EVAPORATORS AS POWER PLANT CONDENSERS TO PRODUCE ABUNDANT FRESHWATER,
California Univ., Berkeley.
For primary bibliographic entry see Field 3A.
W82-03949

UTILIZATION, PLANNING AND PROBLEM EVALUATION OF URBAN ARTERIAL WATERWAYS AND CORRIDORS AS AN URBAN RESOURCE,
Oklahoma Univ., Norman. Dept. of Civil Engineering.
J. F. Harp.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-197922, Price codes: A05 in paper copy, A01 in microfiche. Report prepared under contract with Office of Water Research and Technology, November, 1981. 94 p. OWRT-C-00123-U(0517)(1), 14-34-0001-0517.

Descriptors: Cities, Corridors, Urban recreation, Culture, Sand mining, Ecology, Regime, Sedimentation, Flash floods, Flood plains, *Floodways, Channelization, Physical effects, River meandering, Erosion, Groundwater recharge, Habitats, *Water management, *Streams, *Urban areas, *Flood control, Urban watersheds, Urban hydrology, *Multipurpose projects.

Widespread concern about flooding and possible use of the nation's river corridors has generated unprecedented interest in the potential for utilization of urban riverine corridors while simultaneously protecting the environment. This research effort is directed toward the development of a conceptualized plan to utilize the arterial waterways and intermittent streams as a resource and an asset to the community, so that existing problem areas can be economically transferred into useful and feasible activity centers. Flooding problems and methods of flood mitigation, both structural and non-structural are presented. Physical effects of certain practices, such as sand mining and its effect upon flooding, sedimentation, river regime changes, erosion and backwater are also presented. A river corridor plan is invoked on the basis of a study of the soil, topography, vegetation, hydrology and cultural features assembled and an array of potential benefits from reclaiming the corridors presented. A multi-purpose, multiple-approach river corridor plan strategy has been developed and general application to riverine corridor areas has been made.
W82-03952

AGGREGATION-DISAGGREGATION TECHNIQUES FOR THE OPERATION OF MULTI-RESERVOIR SYSTEMS,
Colorado Water Resources Research Inst., Fort Collins.
R. A. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-197971, Price codes: A11 in paper copy, A01 in microfiche. PhD Thesis, 1981, Colorado State University, Fort Collins. 215 p, 43 Fig, 31 Tab, 70 Ref, 3 Append. B-195-COLO(5), 14-34-0001-9060.

Descriptors: *Reservoir operation, Model studies, *Reservoir releases, Decision making, Reservoir release policy, Reservoir storage, Reservoir power yield, Optimum hydropower production, Power production, *Multipurpose reservoirs, *North Platte River.

The analysis of the best allocation (disaggregation) of the total amount of water available in an aggregated or equivalent reservoir into a multi-reservoir system is performed using the Kuhn-Tucker theorem of mathematical programming. The cases of systems in parallel and in series are specifically studied. It is shown that the optimal allocation is obtained when the marginal benefits of the water

in storage is the same at each reservoir. The yield optimally defined for the aggregated system (a relaxed system) represents an upper bound in yield production for the multi-reservoir system. The disaggregation of the aggregated yield is defined for each period of time as an optimization problem that minimizes the differences between the yield for the aggregated system and for the multi-reservoir system. Mathematical programming algorithms such as Dynamic Programming, Linear Programming, and Quadratic Programming were used to solve this disaggregation problem depending on the system configuration and on the purpose of the system. The use of Linear Programming with weights for the storage volumes in the objective function proved to be the more efficient procedure in all cases studied. The proposed Aggregation-Disaggregation procedure is shown to be very efficient and economical in determining the optimal operation of multi-reservoir systems, and in all cases differences in yield production between the aggregated system (the upper bound) and the multi-reservoir system varied from only 2 to 8 percent. The possible uses of statistical disaggregation techniques for approaching the above-mentioned problem are also explored. First, a statistical disaggregation model is applied for the spatial disaggregation of the aggregated optimal storage volumes to define the operation of the multi-reservoir system. Then the disaggregation model is applied for the temporal disaggregation of optimal decisions at a given time interval to determine the operation at a shorter time interval. The various Aggregation-Disaggregation techniques has been applied to four cases: a water supply system of three reservoirs in parallel; the North Platte water supply system of seven reservoirs in series, a hydropower system of four reservoirs in parallel, and a hydropower system in Brazil composed of six reservoirs and eight power plants.
W82-03954

MULTI-OBJECTIVE DECISION MAKING IN WATER MANAGEMENT,
Institut fuer Wassergute und Landschaftswasserbau, Vienna (Austria).
H. Fleckseder.
Water Science and Technology, Vol 13, No 3, p 115-127, 1981. 29 Ref.

Descriptors: *Decision making, *Water management, *Multiobjective planning, Planning.

The paper presents a basically philosophical discussion of multiobjective decision making with respect to water management. The need to combine empiricism and logic in approaching water management problems is discussed. The pervasiveness of water in the environment is stressed. Local water management decisions may affect very large areas. The need to consider water management decisions in the light of river basins, defined in the widest possible terms, is emphasized. These river basins should include areas affected by water transfers. In addition, receiving bodies should be considered. There is a need for decision-making bodies to cover whole river basins, rather than be limited to small segments of a water system. Multiobjective planning is seen primarily as a means of living with multicontradictions in the domains related to water. (Carrol-FRC)
W82-04010

OPTIMIZATION OF LOOPED WATER DISTRIBUTION SYSTEMS,
SCS Engineers, Inc., Long Beach, CA.
G. E. Quindry, E. D. Brill, and J. C. Liebman.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 665-679, August, 1981. 2 Fig, 5 Tab, 6 Ref.

Descriptors: *Optimization, *Water distribution, Cost analysis, Design criteria, Planning, Mathematical models, Computer models, *Systems analysis, Water supply systems.

Optimization tools can be used to provide valuable information in the initial planning phases of the design process for water distribution systems. In spite of a considerable amount of research on the problem, no method for optimal design of looped water distribution systems which is completely satisfactory has yet been developed. Lai and Schaake have developed a linear programming formulation for use in designing municipal water supply systems, the solution of which provides the least costly pipe system that will meet the required demand of node heads specified in advance. Alperovits and Shamir have developed an iterative technique which uses the solution of a linear program as an intermediate step in a gradient search. Their program requires the advance specification of pipe flows. This paper discusses an optimization technique in which a gradient step is added to the Lai and Schaake formulation, resulting in an algorithm which is computationally simpler than the Alperovits and Shamir technique. This technique can be used to identify critical areas in the design and to suggest improvements in the design to reduce costs. Further research is needed to improve the computer program to more rapidly approach a local optimum for pipe networks in order to make the technique more useful and applicable to water distribution systems. (Carroll-FRC)
W82-04045

MAKING YOUR WAY THROUGH MURKY WATERS-A MANUAL FOR PUBLIC PARTICIPATION COORDINATORS IN NATURAL RESOURCES PLANNING,
North Carolina State Univ. at Raleigh.
J. Franklin, R. Snyder, and J. Wright.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-198060, Price codes: A03 in paper copy, A01 in microfiche. 40 pp, August 1981. OWRT B-120-NC(1). 14-34-0001-9126.

Descriptors: *Public participation, *Planning, Public involvement, Evaluation, Public opinion, *Water resources development.

A manual was designed to help public involvement professionals in natural resources develop a coordinated planning strategy by defining appropriate program goals with means and methods most likely to achieve those specified ends. The purpose of the manual is to shape Public Involvement (PI) programs more by conscious design than by chance or crisis. Strategic planning can help to identify ann reduce the conflicting goals of the various public and agency staff. Careful planning can help to resolve the ambiguities inherent in the role of PI coordinators. Worksheets are used to help in organizing thinking, maintaining a program record, and stimulating focused discussion with others. The manual includes a list of additional reference material.
W82-04085

COMPUTER MODELING PROGRAMS: TOOLS FOR MODEL OPERATIONS,
Denver Water Dept.
A. L. Cesario.
Journal of the American Water Works Association, Vol 72, No 9, p 508-513, 1980. 4 Fig, 4 Ref.

Descriptors: *Model studies, *Systems engineering, Systems analysis, Mathematical studies, Planning, Dynamic programming, Computers, Simulation, *Water distribution, *Water supply systems.

A system of computer programs is needed for use by engineers and planners involved in effectively analyzing water distribution systems. The Denver Water Department has developed such a system for network analysis, centered around a water system analysis program called WATSIM (water simulation). Two basic sets of data are employed: consumption and network. These base data complement three general areas of program development: loading, calibration, and analysis. Programs are both primary and secondary in nature. Primary programs perform calculations and provide answers. Secondary programs manipulate, check, and rearrange data. A computer program called MODELPOP (model population) is used to calculate consumption per section based on data provided in the section demand list. The four types of base network data are: pressure zone boundary, node, pipe, and system characteristics. Another area of program development is network analysis, a process that includes solving networks and converting, combining, and extracting network data files to be used with the analysis program. The general method for doing a long range master plan is to place projected ultimate demands in the calibrated model. Such a system allows engineers and planners performing long range studies to quickly and effectively arrive at future designs. The user has the capability to load, extract and combine networks as desired. (Baker-FRC)
W82-04130

REEVALUATING HUNTER'S MODEL FOR RESIDENTIAL WATER DEMAND,
Stevens Inst. of Tech., Hoboken, NJ.
For primary bibliographic entry see Field 6D.
W82-04131

SPNM, A MODEL FOR PREDICTING SEDIMENT, PHOSPHORUS, AND NITROGEN YIELDS FROM AGRICULTURAL BASINS,
Science and Education Administration, Temple, TX. Grassland, Soil, and Water, Soil, and Water Research Lab.
J. R. Williams.
Water Resources Bulletin, Vol 16, No 5, p 843-848, October, 1980. 3 Tab, 7 Ref.

Descriptors: *Hydrologic models, *Phosphorus, *Nitrogen, Computer models, *Agricultural runoff, Water pollution sources, Fate of pollutants, Path of pollutants, Model studies, *Sediment yield, Nitrates, Simulation analysis, Mathematical studies, Fortran, Computer programs, Sediment load.

A sediment-phosphorus-nitrogen model (SPNM), constructed from 12 subroutines written in FORTRAN, was developed to simulate agricultural contributions to water pollution. Sediment yield from subbasins may be predicted from the modified universal soil loss equation, while P and organic N yields are predicted with loading functions adapted to individual storms. Nitrate yield is calculated from a function dependent upon surface and subsurface flow and the level of nitrate in the surface soil and root zone. SPNM requires input from a runoff simulation model, and sediment is routed with a model that describes deposition and degradation. The SPNM gave realistic results in trials on Little Elm Creek Basin, Texas; however, further testing is needed to evaluate the model's effectiveness. SPNM can be used by hydrologists and environmental engineers with little knowledge of computer programming and should prove useful in water research and in the planning of water resources projects. (Geiger-FRC)
W82-04157

NILE WATER FOR SINAI: FRAMEWORK FOR ANALYSIS,
Consiglio Nazionale delle Ricerche, Milan (Italy). Centro di Teoria dei Sistemi.
G. Guariso, D. Whittington, B. S. Zikri, and K. H. Mancy.
Water Resources Research, Vol 17, No 6, p 1585-1593, December, 1981. 5 Fig, 3 Tab, 27 Ref.

Descriptors: *Land reclamation, *Irrigation programs, *Water resources development, Planning, Long-term planning, *Multiobjective planning, *Nile River, *Sinai, Egypt, Arid lands, Water transport, Canals, Water conveyance, Political aspects, Economic aspects, Model studies, Agriculture.

A multiobjective programming model is formulated to study the tradeoffs between economic and political objectives in Egypt's planned massive expansion of irrigated land in the Eastern Delta and the Sinai. Present plans are to extend the present canal system and build the Peace Canal to deliver Nile water to the new reclamation areas (1.8 million hectares by 2000). The objectives are both economic and political: to increase agricultural production and to establish a permanent Egyptian presence in the region. The model indicates a need for the systematic evaluation of all options in this multibillion dollar project; it is not designed for detailed investment planning. A study of the objec-

tives and their interrelationships with water quantity, water quality, water transport costs, crop rotation, and irrigation techniques shows that the planned project will require modern, water-efficient technologies as well as economic sacrifices. The decisions to be made concerning the reclamation project (canal routes, site selection, and irrigation technology) may be sensitive to the value of water in the rest of the country. This point has not been considered thus far in official plans. Since the investment is so large, large-scale demonstration projects are suggested to test the assumptions upon which the model is based: crop yields, crop water requirements, irrigation system performance, and land reclamation costs. (Cassar-FRC)
W82-04203

A DECOMPOSITION METHOD FOR THE LONG-TERM SCHEDULING OF RESERVOIRS IN SERIES,
Hydro-Quebec, Varennes.
A. Turgeon.
Water Resources Research, Vol. 17, No 6, p 1565-1570, December, 1981. 3 Fig, 9 Tab, 16 Ref.

Descriptors: *Reservoir management, *Hydroelectric plants, *Electric power production, *Reservoir operation, Reservoir releases, Stochastic process, Optimization, Dynamic programming, Multireservoir networks, Planning, Operating policies.

A method is presented for determining the weekly operating policy of a hydroelectric power system with several reservoirs in series on a river. This paper is concerned with the strategic aspects of reservoir management (the amount of water to release from each reservoir weekly or monthly to achieve the maximum benefits). The method considers the stochasticity of river flows and neglects water travel time, seepage losses, evaporation losses, transmission losses, and competing water uses. It consists of decomposing the stochastic nonlinear optimization problem of n state variables (n = number of reservoirs) into n -1 problems of 2 state variables which are then solved by dynamic programming. The method is simple, easy to program, not iterative, and can be used with confidence for large systems. The method is applied to a 4 reservoir system. Comparing a global feedback solution (true optimum derived from a recursive equation) and the simplier local feedback solution presented in this paper showed agreement within 1% in yearly profits at the $25 million level. Comparing high and low flow years with global and local feedback solutions gave results of $28,165,760 and $28,145,330, respectively, for the high flow year and $21,331,750 and $21,155,030, respectively, for the low flow year. (Cassar-FRC)
W82-04205

THE WISCONSIN SOIL AND WATER CONSERVATION DISTRICT AS AN INSTITUTION TO UNDERTAKE SUBWATERSHED PLANNING TO CONTROL NON-POINT SOURCE WATER POLLUTION,
Wisconsin Univ.-Madison.
E. J. Strauss.
PhD Thesis, 1981. 291 p, 1 Fig, 34 Tab, 163 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-16678.

Descriptors: *Watershed management, *Comprehensive planning, *Water quality management, *Nonpoint pollution sources, Erosion control, Soil conservation, Subwatershed planning, *Wisconsin, Soil and Water Conservation Districts.

The possible development of a new planning function for an existing institution, the Soil and Water Conservation District (SWCD) is discussed. The research tests the capacity of SWCDs to undertake continuous non-point source water quality planning or the type suggested by P.L. 92-500, the Federal Water Pollution Control Act Ammendments of 1972. Through adopting an organizational theory perspective, four problem areas (institutional selection, historical performance, current resources and future desires) are individually analyzed from three problem aspects (environment, inter-organizational and intra-organizational). Two types of new plans are proposed to all SWCD supervisors and a selected number of employees in the soil conservation organizational network. The first is a subwatershed plan to be undertaken by the SWCD as an update to the Section 208 planning process. Such a plan covers both incorporated and unincorporated areas of the county. The second is a detailed erosion control plan which would be required of all individuals in the county who engage in earth-moving disturbances. The SWCD would review such plans and current farm plans would provide an acceptable substitute. The purpose of the plans is to demonstrate a mechanism by which the SWCD can undertake subwatershed planning to control non-point source pollution. The research demonstrates that the watershed is an appropriate basis for water quality planning. In most cases the county is the unit of government which most closely conforms to this area. It is suggested that the SWCD is an appropriate county institution to undertake subwatershed planning. (Sinha-OEIS)
W82-04212

MODELING A SOCIOLOGICAL-HYDROLOGIC FLOOD CONTROL DECISION SYSTEM,
Utah State Univ., Logan. Inst. for Social Science Research on Natural Resources.
W. H. Andrews, J. P. Riley, and M. B. Masteller.
Water Resources Bulletin, Vol 16, No 2, p 194-202, April, 1980. 2 fg, 3 Tab, 13 Ref. OWRT (5177(4207).

Descriptors: *Social aspects, *Flood control, *Decision making, *Model studies, Computer models, Public opinion, Hydrologic models, *Costs, Aesthetics.

A model for analyzing the social components of a flood control decision process is presented. Six mathematical equations are developed to allow computer simulation. These stages of the model involve public opinion about the need for flood control in the local area, preliminary decision on whether action is needed, screening of potential actions, public reactions toward the potential actions, consideration of alternative actions if necessary, and consideration of the effect of the social decisions on the watershed and its drainage characteristics. Tables are given listing 25 population variables (such as perceived esthetic or ecological effects of a flood control proposal) and 25 agency variables (such as actual flood control benefits and cost of proposal). (Cassar-FRC)
W82-04221

MAPS--A PLANNING TOOL FOR CORPS OF ENGINEERS REGIONAL WATER SUPPLY STUDIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski.
Water Resources Bulletin, Vol 16, No 2, p 215-219, April, 1980. 11 Ref.

Descriptors: *Water supply, *Cost estimates, *Regional planning, Water distribution, Planning, Computer models, *Model studies, Methodology for Areawide Planning Studies, Water management, Pipes, Design criteria, Water resources development, Water treatment, U.S. Army Corps of Engineers, Salinas, Monterey, California, Nashville, Tennessee, Urban planning, Alternative planning.

MAPS (Methodology for Areawide Planning Studies) is a set of computer-based models developed by the U.S. Army Corps of Engineers to produce a large number of alternatives in water supply planning. Unlike most computer programs which solve a single problem or type of problem the multipurpose MAPS contains four modules: water balance (for simulation of system behavior for different flows and water use management schemes), design (including several submodules-force main, gravity main, open channel, pipeline, pump stations, reservoir, storage tanks, tunnels, water treatment, wastewater treatment, and well-field), Hardy-Cross network analysis (to determine the head at nodes and pipeflow for a looped or tree structured pipe system), and amortization. Use of MAPS is illustrated in studies of the identification and cost determination of combinations of water source, transmission, and treatment to meet an array of future water needs for Salinas-Monterey, California, and Nashville, Tennessee. In both cases a very large number of alternatives was evaluated. Whereas the results of the California study were presented as a whole, the Tennessee study gave 2 to 5 alternative facility plans for each of the many utility districts in the study area. (Cassar-FRC)
W82-04228

CAPACITY EXPANSION PLANNING MODEL FOR WASTE WATER TREATMENT AND I/I CONTROL,
Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5D.
W82-04239

6B. Evaluation Process

USE OF A PREDICTIVE MODEL IN EVALUATING WATER CONSUMPTION CONSERVATION,
Iowa State Univ., Ames. Dept. of Sociology and Anthropology.
For primary bibliographic entry see Field 3D.
W82-03754

ENVIRONMENTAL ASPECTS OF WATER-RESOURCES PLANNING IN ENGLAND AND WALES,
Department of the Environment, Reading (England). Central Water Planning Unit.
For primary bibliographic entry see Field 6E.
W82-03806

THE COSTS OF INTERNAL COROSION IN WATER SYSTEMS,
Collins, Ryder and Watkins, Inc., Tacoma, WA.
For primary bibliographic entry see Field 5F.
W82-03809

POTENTIAL IMPACT OF GROUND WATER POLICY ALTERNATIVES ON NEBRASKA AGRICULTURE, 1977-2020,
Nebraska Univ.-, Lincoln.
A. G. Leholm.
PhD Thesis, May 1981. 215 p, 9 Fig, 32 Tab, 46 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-20166.

Descriptors: *Groundwater management, *Water policy, *Agriculture, Water requirements, Irrigation, Crop production, Future planning, Economic aspects, Model studies, *Nebraska.

Nine Agricultural and related ground water policy scenarios were analyzed for Nebraska over the time period 1977-2020 to determine how they might influence returns to land and management, farm production and aquifer conditions. A BASELINE scenario served as the yardstick for measuring all other scenarios. A recursive linear programming (RLP) model was developed for the study. The RLP framework enabled an analysis of the many physical and economic forces which impact simultaneously on the agricultural production process. The RLP model's solution constituted an optimum with respect to maximizing returns over variable costs, yielded the level of the various ground water irrigated and dryland crops grown and provided the impact of ground water irrigated crop production on the aquifer. The BASELINE scenario results show an overall bright future for Nebraska's ground water irrigated and dryland agriculture. However, under the BASELINE scenario by the end of 2020 almost 2.5 million acres of previously irrigated land had reverted to dryland. Three ground water restriction scenarios which limited water application on a per developed irrigation acre basis were analyzed, but relative to the BASELINE 1.4 million fewer acres were exhausted by the year 2020. Three scenarios were analyzed which either involved a rapid adoption of a new irrigation technology or an improvement in irrigation efficiency. Significant gains were shown for these scenarios over the BASELINE. Two

scenarios were analyzed that prohibited ground water irrigation development after 1984. The development restriction scenarios do not appear to be viable policy alternatives. (Sinha-OEIS)
W82-03826

READYING BOSTON'S WATER AND SEWER SYSTEM FOR THE NEXT CENTURY,
P. Hersch.
Water/Engineering and Management, Vol 128, No 11, p 12, November, 1981.

Descriptors: *Management planning, *Sewer systems, Decision making, Planning, *Municipal water, *Boston, Pipelines, Conveyance structures, Water mains, Pipes, *Water supply systems.

The newly formed Water and Sewer Commission in Boston is well on its way to dealing with seriously deteriorated water and wastewater conduits in that city, a problem in many large cities in older sections of the country. Selection of water pipe for replacement and rehabilitation is done on the basis of maintenance records, age records, loss-of-head tests, and fire-flow tests. Then, management carefully considers plans by city and state agencies involved with street rebuilding and other in-street repair. Finally, management trades off improvements according to chronology and urgency against the benefits of working with readily accessible pipe. Good management principles have been followed in setting rates to cover expenses and minimizing losses to reduce expenses. The distribution and collection operations are integrated at the management level, eliminating duplication and saving money. Projects are being accelerated so they can be bid under current economic conditions. An aggressive leak repair program is part of the plan. Other money saving concepts include sending in water or wastewater teams to assess the need for minor repairs of piping systems wherever any construction has unearthed pipes or valves, regardless of the repair schedule for the pipe in that area, purchasing meters that are less costly to read, and selling meters that are being replaced. The commission has also started training programs to ensure the quality of management and staff. (Baker-FRC)
W82-03870

PRIMARY AND SECONDARY IMPACTS OF A WATER RESOURCE DEVELOPMENT PROJECT,
Idaho Univ., Moscow. Dept. of Agricultural Economics and Applied Statistics.
R. B. Long.
Water Resources Bulletin, Vol 16, No 6, p 1002-1005, December, 1980. 1 Fig, 3 Tab, 2 Ref.

Descriptors: *Irrigation, *Water resources development, *Economic aspects, Food processing industry, Benefits, Cost-benefit analysis, *Boise River project, *Idaho, Income, Input-output analysis.

An economic analysis of the 70-year old Boise River water resource development project revealed income benefits, both direct (from irrigation) and indirect (from the food processing industry). Irrigated acreage increased from 33,377 acres in 1910 to 342,528 acres in 1970. Income impacts from irrigation were: $17.9 million direct and $45.9 million indirect in 1947. $28.2 million direct and $99.1 indirect in 1970. Income impacts from food processing were: $9.9 million direct and $36.6 million indirect in 1947 and $29.3 million direct and $114.5 million indirect in 1970. Benefit-cost ratios varied from 0.88 in 1910 to 5.56 in 1950. The large indirect or secondary benefits from water development demonstrated in this study indicate that they should be considered in evaluations of future projects. (Cassar-FRC)
W82-03907

A RETROSPECTIVE BENEFIT-COST ANALYSIS OF WATER RESOURCE PROJECTS IN THE CUMBERLAND RIVER BASIN,
Law Engineering Testing Co., Marietta, GA.
W. J. Martin, and E. L. Thackston.
Water Resources Bulletin, Vol 16, No 6, p 1006-1011, December, 1980. 3 Fig, 2 Tab, 3 Ref.

Descriptors: *Cost-benefit analysis, *Reservoirs, *Performance evaluation, Projects, Economic analysis, Benefits, Recreation, Flood control, Rate of return, Cumberland River Basin, Electric power, *Cumberland River basin, Kentucky, Tennessee.

The ex post performance and ex ante estimates were compared for several reservoirs in the Cumberland River Basin, Kentucky and Tennessee. The actual benefit-cost ratio as compared with the ex ante estimate for each project was as follows: Dale Hollow, 1.24 and 1.46; Wolf Creek, 1.40 and 1.53; Center Hill, 1.17 and 2.02; and J. Percy Priest, 1.45 and 1.6. Benefits and costs were deflated to their year of initial construction (1942, 1941, 1942, and about 1968, respectively). Categories used were cost, flood control benefits, power benefits, and recreation benefits. Wolf Creek reservoir costs were 53% of estimated costs. The other 3 dams cost an average of 48% more than expected. Projected flood control benefits were too high for two projects and too low for two projects. The actual numbers of kilowatt hours generated were only 5-18% of the original estimates in the three older projects. Recreational benefits were much higher for the newer dam and infinitely higher for the three older dams because recreational benefits had not been considered at the time of construction. Internal rates of return ranged from 3.75 to 7%. Factors responsible for differences between estimated and actual performance were World War II (postponed construction and realization of benefits), use of outdated flood stage damage curves, and not basing power benefits on open market values. More frequent ex post analyses of public expenditures should be applied to adjust policies to changing circumstances. (Cassar-FRC)
W82-03917

NORMALIZED AGRICULTURAL PRICES AND WATER RESOURCES PLANNING,
Utah Univ., Salt Lake City. Dept. of Economics.
J. R. Miller.
Water Resources Bulletin, Vol 16, No 3, p 471-476, June, 1980. 4 Tab, 14 Ref.

Descriptors: *Agriculture, *Market value, *Prices, Normalized prices, Irrigation, Future planning, Costs, Statistical analysis, Water resources development.

Both the linear trend (LT) and the weighted average normalizing (WA) procedures performed reasonably well in normalizing agricultural market prices, necessary for water resources planning. Mean absolute divergences from true present values were 11.6% and 10.6% for the LT and WA methods, respectively, in a list of 34 crop and livestock categories. However, neither was satisfactory in analysis of crops with frequent and dramatic price changes, such as oranges. WA appeared better than LT in the livestock category. Crops with the least divergence from present values were grains. (Cassar-FRC)
W82-03928

IMPACT OF FLOOD HAZARD ON RESIDENTIAL PROPERTY VALUES IN GALT (CAMBRIDGE), ONTARIO,
Toronto Univ. (Ontario).
M. Babcock, and B. Mitchell.
Water Resources Bulletin, Vol 16, No 3, p 532-537, June, 1980. 7 Fig, 15 Ref.

Descriptors: *Property value, *Flood plain management, *Attitudes, Planning, Public opinion, Real property, *Flood damage, *Galt, *Ontario, Prices, Urban areas, Evaluation.

A study of property values in Galt, Ontario, showed that sales prices in both high and low risk areas were not singnificantly different before and after a major flood in 1974. All prices were higher during the 4 years after the flood than during the 4 years before the flood. Prices were also higher in the high risk area than in the low risk area. Sales prices, assessment values, and a questionnaire on perceptions of property values were used to reach these conclusions. Respondents to the questionnaire believed that property values increased since the flood but, conversely, said that flooding had an adverse effect on property values. Both homeowners and realtors believed that location was the most important factor affecting property values. River locations were, in fact, more expensive and desirable than low risk area properties. Land acquisition programs for buying flood plain properties may be difficult to implement when there is a conflict in perception of property values. When the public perceives little flood risk, property prices remain high. (Cassar-FRC)
W82-03929

INSTITUTIONAL ANALYSIS CRITERIA FOR WATER SUPPLY PLANNING,
Mathematical Sciences Northwest, Inc., Bellevue, WA.
For primary bibliographic entry see Field 6D.
W82-03930

AN EVALUATION OF RECREATIONAL BENEFITS AND USE ESTIMATING MODELS FOR WATER RESOURCE PLANNING,
George Washington Univ., Washington, DC. Dept. of Engineering Administration.
R. C. Waters, and V. Moustakis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-198003, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center, University of the District of Columbia Report No. 31, October, 1981. 46 p, 4 Fig, 5 Tab, 64 Ref. OWRT-A-012-DC(1), 41-34-0001-0109.

Descriptors: *Recreational benefits, *Recreational use, Contingency valuation method, Unit day values, Water Resources Council, *Recreation facilities, *Literature review, Social aspects, Economic aspects.

The objective of the study was (1) to collect and analyze the available recreational benefit estimating models applicable to the development of federal water resource plans, (2) to determine the degree of congruity and generality which exists in the present body of research, and (3) to evaluate the several recreational benefits esiimation methods from the perspective that substitutes to the services provided by the new site are considered. A literature search of over 300 abstracts was conducted resulting in the in depth review of 45 studies (annotated abstracts are provided). Fifteen studies include a consideration of substitutes, however each lack the inclusion of one or more of the following considerations: income of participants, conjustion, site quality, and the site as an intermediate destination. Furthermore the validity and reliability of all the studies are undetermined. No ex post analysis of the model results has been conducted. Also a number of the models are based on inadequate data collection methods and small sample sizes. Recently the U. S. Water Resources Council indicated it would publish regional recreational models (i.e., ones which account for substitutes) that may be used to evaluate proposed projects. It is doubtful at present that the existing literature provides models which provide a sound basis for water resource plans. Additional research is necessary.
W82-03942

AN ECONOMIC EVALUATION OF INTERBASIN WATER TRANSFERS: A CASE STUDY OF SOUTHWESTERN CONNECTICUT,
Connecticut Univ., Storrs. Inst. of Water Resources.
L. R. Fattarusso, and M. A. Altobello.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-197955, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, 1981. 18 p, 1 Fig, 5 Tab, 17 Ref. OWRT-A-086-CONN(1), 14-34-0001-0107.

Descriptors: Water resources planning, *Southwestern Connecticut, Water supply alternatives, Linear programming model Cost estimates, Optimal regional water allocation, *Water supply development, *Water demand, *Economic feasibility, Connecticut, *Model studies.

A water resources planning model was developed to determine the least cost method of supplying southwestern Connecticut with potable water to meet its demand requirements. The water supply alternatives were evaluated with the aid of a linear programming model of the transporation type for the years 1979, 1985, and 2000. Cost estimates used in analyzing regional water allocation in the year 1979 were obtained from historical data, whereas projected cost estimates for 1985 and 2000, were estimated from formulas appearing in the literature. It was found that the optimal regional water allocation plan resulted in significant cost savings when compared to the actual situation in 1979 and the projected version of each in the years 1985 and 2000. Given total available water supply and demand estimates for the years 1985 and 2000, in the aggregate, conditions of excess water supply should prevail in Southwestern Connecticut, barring shortages caused by a natural catastrophe, such as severe drought or unforeseen decline in water quality resulting in reductions in available supply.
W82-03944

PRELIMINARY WATER-QUALITY ASSESSMENT OF THE UPPER WHITE RIVER NEAR INDIANAPOLIS, MARION COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
D. J. Wangsness, S. E. Eikenberry, W. G. Wilber, and C. G. Crawford.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $7.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-408, March, 1981. 50 p, 12 Fig, 14 Tab, 42 Ref.

Descriptors: *Water quality, *River basins, *Recreation facilities, Surface water, Water quality standards, Streamflow, Low flow, Bacteria, Dissolved oxygen, Nutrients, Metals, Phytoplankton, Water pollution sources, *Indiana, Marion County, Indianapolis, White River, *Baseline studies, Parks, Planning.

The White River Park Commission is planning the development of park facilities along the White River through Indianapolis, Ind. A key element in the planning is the determination of whether water quality of the river is suitable for recreation. A preliminary water-quality assessment conducted August 4-5, 1980, indicated that, during low-flow steady-state conditions, the river is suitable for partial body contact recreation (any contact with water up to, but not including complete submergence). Dissolved-oxygen concentrations varied but were higher than the Indiana water-quality standards established to ensure conditions for the maintenance of a well-balanced, warm-water fish community. High fecal-coliform densities that have been observed in the White River during high streamflow are probably caused by stormwater runoff carried by combined storm and sanitary sewers. However, during the low-flow, steady-state conditions on August 4-5, 1980, fecal-coliform densities were within the Indiana standards for partial body contact recreation. Quantities of organic matter and concentrations of nutrients and heavy metals in the White River were generally within the limits recommended by the U.S. Environmental Protection Agency and were generally similar to values for other Indiana rivers. Chromium, copper, lead, zinc, and mercury are accumulating in bottom materials downstream from 30th Street. The phytoplankton concentrations in the White River were high. The dominant phytoplankton species were indicative of rivers moderately affected by organic wastes. (USGS)
W82-03986

O & M COSTS AND OPTIMAL CAPACITY EXPANSION,
California Univ., Richmond. Sanitary Engineering Research Lab.
F. Pearson, and C. R. Scherer.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 619-633, August, 1981. 6 Fig, 1 Tab, 6 Ref.

Descriptors: *Optimization, *Wastewater facilities, *Cost analysis, Maintenance costs, Operating costs, Wastewater treatment, Capital costs, Construction costs.

Planners of wastewater treatment facilities which handle a load or demand that increases with time must decide whether to construct a few large increments in capacity or many smaller ones. Staffing guidelines for the operation and maintenance of wastewater treatment facilities generally base recommended staff levels on installed capacity, implying that operating and maintenance costs increase not only with increasing load handled, but also with increasing installed capacity. Given the particular load handled by a facility, capacity-dependent operating and maintenance costs are higher for those plants with greater unused installed capacity. Increasing excess capacity results in increasing off-design cost margins. Optimal capacity expansion schedules which minimize total cost (capital plus load and capacity-dependent operating and maintenance costs) provide smaller, more frequent expansions than schedules designed to minimize only capital costs or capital costs plus operating and maintenance costs that depend only on actual flow and not on installed capacity. Analytical expressions identifying the optimal time interval between successive equal-sized capacity expansions needed to minimize total cost are developed for the case of a load increasing linearly with time. Dynamic programming resulted in the same expansion schedule for least total cost as that obtained analytically. (Carroll-FRC)
W82-04042

CONSIDERATIONS IN CHOOSING THE APPROPRIATE MIX OF URBAN AND AGRICULTURAL NONPOINT POLLUTION CONTROL,
Tennessee Univ., Knoxville. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 5G.
W82-04063

THE COST OF PEAK CAPACITY WATER,
Calgary Univ. (Alberta). Dept. of Civil Engineering.
M. Gysi.
Water Resources Bulletin, Vol 17, No 6, p 956-961, December, 1981. 3 Tab, 5 Ref.

Descriptors: *Water metering, *Peak demands, Capacity, *Calgary, *Alberta, *Cost analysis, Water supply, Urban planning, Planning, Water conservation, Marginal costs, Pricing, Water rates, Water demand.

Calgary, Alberta, is planning expansion of its water supply to meet peak summer demands, which increased from 716,000 cu m per day in 1978 to 925,000 cu m per day in 1979. Since most of the city's residential water is sold by flat rate, it is recommended that metering should be started immediately, before a capacity expansion. Metering all newly-built houses and installing 35,000 to 40,000 meters per year for 5 years would cost $2 or $3 million per year. An addition to the water supply facilities would cost $65 million and add an extra interest debt of $7 million per year to the utility. If complete metering dropped the city's consumption by 30%, the present water plant would be sufficient for several more years. With metering and no expansion water output would be inadequate on 2 days, in 1984, 3 days in 1985, and 5 days, in 1986. (Cassar-FRC)
W82-04065

A STUDY OF THE MSF DESALINATION PROCESS UTILIZING THE CONTROLLED TWO-PHASE FLOW CONCEPT--PHASE II,
Coury and Associates, Inc., Lakewood, CO.
For primary bibliographic entry see Field 3A.
W82-04084

DIRECT FILTRATION TREATMENT PLANTS: COSTS AND CAPABILITIES,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5F.
W82-04128

CURBING THE DISTRIBUTION ENERGY APPETITE,
Black and Veatch, Kansas City, MO.
For primary bibliographic entry see Field 5F.
W82-04136

HYDROPOWER: INFLATION-PROOF ENERGY FROM WATER SUPPLY DAMS,
Burgess and Niple Ltd., Columbus, OH.
L. E. Linzell.
Journal of the American Water Works Association, Vol 72, No 6, p 321-325, June, 1980. 5 Fig, 1 Tab.

Descriptors: *Hydroelectric power, *Feasibility studies, *Water supply, Dams, *Columbus, Ohio, Energy sources, Electric power, Peaking capacity, *Economic feasibility, Environmental effects, Costs.

The economic feasibility of hydropower development at three existing municipal water supply dams in Columbus, Ohio, is discussed. The three low head dams (10-20 m) have hydroelectric potentials of 5 MW, 2 MW, and 500 MW. O'Shaughnessy and Griggs Dams, the smaller projects, are analyzed in detail. At the project costs of $4 million or less each, the benefit/cost ratios are 2.31 and 1.37, respectively. Also discussed are means of conveying the raw water to the turbine (streambed or pipeline) and location of the hydroelectric plant (at the dam or at the water plant). Releasing the daily water demand over a period of a few hours through a large capacity turbine allows increased energy production at low streamflows. An intermediate reservoir between water plant and dam allows best utilization of available flow for peaking. Power produced can be used by the water treatment plant and by the municipal government. Environmental impacts are minimal but may include loss of aeration in downstream water, stagnant water during low flow periods, rapid variations in flow if peaking is used, and construction disruptions. (Cassar-FRC)
W82-04137

CONTROLLING THE COST OF SYSTEM MAINTENANCE,
Los Angeles City Dept. of Water and Power, CA.
For primary bibliographic entry see Field 8G.
W82-04139

THE ECONOMIC EFFECTS OF CHANGES IN WATER USE IN THE TUCSON BASIN, ARIZONA,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6E.
W82-04156

COST-EFFECTIVENESS ANALYSIS FOR ON-SITE WASTEWATER TREATMENT ALTERNATIVES,
Donohue and Associates, Inc., Sheboygan, WI.
For primary bibliographic entry see Field 5D.
W82-04185

PROJECTIVE EVALUATION DURING INFLATION, REVISITED: A SOLUTION TO TURVEY'S RELATIVE PRICE CHANGE PROBLEM,
Executive Office of the President, Washington, DC. Council of Economic Advisers.
S. H. Hanke, and R. W. Wentworth.
Water Resources, Vol 17, No 6, p 1737-1738, December, 1981. 7 Ref.

Descriptors: *Cost-benefit analysis, *Prices, *Economic evaluation, Benefits, *Project planning, Inflation, Evaluation, Planning.

Benefit-cost analysis in cases where relative prices change during the life of a project must include a forecast of general price inflation. It is also necessary to choose a proper numeraire, in this case, present dollars. Use of these techniques solves the problem posed by Turvey (1971) in which the real discount rate is 8% per year and the price of labor

increases at 3% relative to the price of project benefits. (Cassar-FRC)
W82-04202

NILE WATER FOR SINAI: FRAMEWORK FOR ANALYSIS,
Consiglio Nazionale delle Ricerche, Milan (Italy). Centro di Teoria dei Sistemi.
For primary bibliographic entry see Field 6A.
W82-04203

EVALUATION OF HYDROPOWER POTENTIAL IN A RIVER BASIN,
Texas Univ. at Austin.
H. C. Kariyawasam.
PhD Thesis, May, 1980. 156 p, 18 Fig, 23 Tab, 41 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-21455.

Descriptors: *Energy sources, *Model studies, *Hydroelectric power, River basins, Reservoirs, Precipitation, Runoff, Evaluation, Potential water supply, *Texas, *San Antonio River Basin.

A methodology is described to evaluate the available hydropower potential in a river basin. The proposed model can be used to evaluate the available hydropower potential at five different levels of gross and net potential: (1) gross precipitation potential, (2) gross surface potential, (3) gross river potential, (4) net potential with reservoirs meeting individual power demands, and (5) net potential with reservoirs operating as a single system. This model requires only minimum data available at most of the river basins of the world. However, additional optional data can be used, depending upon availability, to get more accurate results. The model is demonstrated by application to the San Antonio River Basin in Texas. Relationships between different levels of gross and net potential are analyzed. Application of this method of analysis to other natural energy sources is suggested. Future possible modification and improvements to the model are proposed. (Sinha-OEIS)
W82-04214

AN EX POST ANALYSIS OF THE UNCOMPAHGRE PROJECT,
Philippines Univ., Manila. School of Economics.
W. H. Sander, III.
Water Resources Bulletin, Vol 16, No 2, p 189-193, April, 1980. 5 Tab, 9 Ref.

Descriptors: *Cost-benefit analysis, *Economic efficiency, *Regional development, *Colorado, Benefits, Uncompahgre River, Gunnison River, Taylor River. Economic development, Agriculture, Water transport, Diversion channels, Reservoirs, Storage.

The Uncompahgre Project, Colorado, authorized by the Bureau of Reclamation in 1903, has been marginal in terms of economic efficiency but has been an important impetus to economic growth in the region. This project consists of a storage reservoir on the Taylor River and a system of dams and canal for diverting water from the Uncompahgre and Gunnison Rivers. Benefit-cost ratios were computed at 3% and 6% discount ratios for low, medium, and high production. These ratios were 1.1 at 3% discount rate and low production cost estimates and less than 1 (0.6 to 0.9) for all other combinations of discount rate and production. However, the project's share in the regional agricultural economic base increased from 22.8% in 1910 to 67.5% in 1970. The project's share in the general regional economic base was 30-40% from 1930-1970. (Cassar-FRC)
W82-04218

ENERGY, ENVIRONMENTAL, AND ECONOMIC IMPLICATIONS OF SOME RECENT ALBERTA WATER RESOURCES PROJECTS,
Calgary Univ. (Alberta). Dept. of Civil Engineering.
M. Gysi.
Water Resources Bulletin, Vol 16, No 4, p 676-680, August, 1980. 9 Ref.

Descriptors: *Water resources development, *Cost-benefit analysis, *Economic analysis, *Alberta, Energy loss, Environmental effects, Water supply, Municipal water, Flow regulation, Dams, Reservoirs, Flood control, Benefits, Sensitivity analysis, Political aspects.

Four water projects in Alberta are discussed as examples of works which have been planned or built according to political decisions rather than economic analysis. This situation has led to energy, environmental, and economic losses in some cases. The Innisfail Regional Water Supply Plant pumps water uphill about 200 meters to the consuming communities. Planners overlooked the fact that the Bow River, uphill from these communities, could adequately supply water by gravity flow. In addition, the pipe sizes and pump capacities at Innisfail appear to be inadequate for future expansion. The City of Calgary recently expanded its water supply facilities at a cost of $10 million. This would not have been required if the residential area had been metered to cut down the daily demand of 800 liters per capita. The Red Deer River Flow Regulation Dam benefit-cost ratio was not revealed to the public. The proponents were interested in boosts to industrialization and employment. In fact, a petrochemical plant was included among the benefits of the dam, even though the plant construction had been approved long before the dam was considered. Industrialization in this area is not totally dependent on the presence or absence of this dam. Benefits in constructing the dam are increased winter flow and raising of dissolved oxygen levels downstream. Flood control benefits are negligible although highly publicized. The Oldman River Flow Regulation Project, not yet approved, was the subject of two benefit-cost analyses. The Phase I ratio was 1.6:1. However, if questionable secondary benefits are subtracted, the ratio is 0.6:1. The Phase II study used inflated secondary benefits, a 5% discount rate, and some unlikely assumptions. Sensitivity analysis using a correct methodology would produce benefit/cost ratios less than 1. (Cassar-FRC)
W82-04226

INTERNATIONAL DECADE ON DRINKING WATER AND SANITATION,
Bureau of International Organization Affairs, Washington, DC.
For primary bibliographic entry see Field 6E.
W82-04230

ECONOMICS OF CONTROLLING NATURAL SALT SOURCES IN THE ARKANSAS RIVER BASIN,
Oklahoma State Univ., Stillwater. Dept. of Economics.
K. W. Olson.
Water Resources Bulletin, Vol 16, No 2, p 294-299, April, 1980. 4 Tab, 24 Ref.

Descriptors: *Economic aspects, River basin development, *Arkansas River Basin, River basins, Salt balance, Cost-benefit analysis, Chlorides, Costs, Cost analysis, Water quality, Water supply, *Salinity control.

Government water resource agencies are required to evaluate proposed projects with the aid of cost-benefit analysis, on the assumption that this procedure will screen out all projects that do not promise benefits greater than costs. This analysis (CBA) is only a framework for evaluation, and its effectiveness in identifying inefficient projects is determined by what is ultimately identified as a benefit or a cost, and by how their values are estimated and compared. The benefits and costs can be so poorly specified and evaluated that CBA actually becomes a tool in some cases for camouflaging, rather than exposing, inefficient projects. In the case presented, errors in both methodology and evaluation were noted. The former appear to produce an upward-biased estimate of the benefit-cost ratio by inducing overestimates of the total demand for water, the demand for the Arkansas River water, and the cost savings realized as a result of the Arkansas River Basin Chloride Control Project. Moreover, improper specification of treatment costs for steam electric generating plants, gross output earnings ratios, and treatment costs can result in large overestimates. Two errors in discounting procedures were also uncovered. (Baker-FRC)
W82-04234

FLOODPLAIN DELINEATION: AN ECONOMIC APPROACH,
Colorado Univ. at Denver. Dept. of Civil and Urban Engineering.
For primary bibliographic entry see Field 6F.
W82-04236

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

AN ANALYSIS OF THE EFFECTS OF ALTERNATIVE MEASURES OF PRICE ON THE DEMAND FOR WATER BY SELF-SUPPLIED INDUSTRIES,
Arkansas Univ., Fayetteville.
S. E. Bell.
PhD Thesis, August 1981. 125 p, 82 Ref, 2 Append, 22 Exhibits. University Microfilms International, Ann Arbor, MI; Order No GAX81-27291.

Descriptors: *Industrial water, *Industrial development, *Water demand, Cost analysis, *Pricing, Economic aspects, Cost allocation, Marginal costs, Water quality.

The primary objectives of the study was to test the effects on the estimated demand for industrial intake water of substituting marginal for average cost as a proxy variable for the price of intake water. To meet this objective, a multiple regression model based on sample data from a small population of heavy water-using firms within the state of Arkansas was used to test whether the choice of a surrogate price variable has any statistically significant effects on the estimate of industrial water demand. The secondary objective was to examine the identification problem inherent in the use of average or marginal cost as a surrogate variable for the price of self-supplied water in the estimation of industrial water demand. A discussion of the identification problem appears in chapter three. The statistical results of the study did not present a strong argument for suggesting that marginal cost was a superior variable. On the contrary, the evidence reinforced the results of previous studies which used average cost as a proxy for intake water. (Sinha-OEIS)
W82-03828

PROJECTED EFFECTS OF ENERGY POLICIES ON AGRICULTURAL WATER USE AND IRRIGATION,
Iowa State Univ., Ames. Center for Agricultural and Rural Development.
E. O. Heady, B. C. English, and D. Dvoskin.
Water Resources Bulletin, Vol 16, No 6, p 1012-1019, December, 1980. 6 Fig, 6 Tab, 3 Ref.

Descriptors: *Water use, *Prices, *Irrigation, *Energy, Water costs, Agriculture, Land use, Natural gas, Regulations, Fertilizers, Energy policy impact.

The impacts of alternative energy policies on agricultural production, land use, and irrigation were evaluated using a national and interregional prorамming model. The five alternatives were: (A) baseline, 1975 energy levels with no natural gas deregulation, (B) natural gas deregulation, (C) natural gas curtailment, (D) doubled energy prices, and (E) tripled energy prices. Model restraints guaranteed that water, land, nitrogen fertilizers, and energy remained at realistic levels. Natural gas deregulation and tripled energy prices would reduce the amount of land receiving full nitrogen fertilization by 4 million acres and 10 million acres, respectively, but would decrease irrigated acreage by only 600,000 acres or less. Shadow prices for irrigated land would increase under all alternatives. Increased energy prices would increase the use of surface water and decrease the use of groundwater for irrigation. The actual percentage

changes would vary greatly according to the region and the alternative. The largest reduction in groundwater use would occur in the South Central and Western U.S. All alternatives would increase water prices, varying with region and alternative. These increases are larger in areas using more groundwater. Natural gas curtailment would produce greater water price increases than natural gas deregulation. Oklahoma, Texas, New Mexico, and Arizona would suffer the greatst water price increases from natural gas deregulation or curtailment. (Cassar-FRC)
W82-03915

THE COSTS OF COMPLIANCE: AN EPA ESTIMATE FOR ORGANICS CONTROL,
Environmental Protection Agency, Cincinnati, OH.
R. M. Clark, and P. Dorsey.
Journal of the American Water Works Association, Vol 72, No 8, p 450-457, 1980. 6 Fig, 14 Tab, 11 Ref.

Descriptors: *Water treatment, *Costs, Economic aspects, Cost analysis, Drinking water, *Water demand, *Water supply, Water quality, Public health, Public opinion, Attitudes.

Capital and operation and maintenance cost designs were developed for a series of unit processes involved in estimating costs for utility compliance with the organics regulations. These cost designs were presented as a function of given design parameters. The cost data are intended to be sufficiently accurate for preliminary planning and flexible enough for cost effectiveness studies. The economic impact of meeting these requirements will be site-specific. Implementing the changes may increase the cost of water supply to the individual utilities affected by 20% or more. There is a great deal of controversy over the benefits to be obtained from implementing these standards. Specific costs discussed include costs of alternative disinfectants such as chlorine, ozone, and chlorine dioxide; granular activated carbon costs; design considerations; contact time; and use rate and inflationary effects. (Baker-FRC)
W82-04132

CAN PRICES TAME THE INFLATIONARY TIGER,
Montana State Univ., Bozeman. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6D.
W82-04142

SIZING AND SELECTING MODERN WATER METERS,
For primary bibliographic entry see Field 6D.
W82-04194

THEORY AND REALITY IN ALLOCATING FEDERAL RESOURCES TO WATER RESOURCES DEVELOPMENT,
George Washington Univ., Washington, DC. Dept. of Engineering Administration.
For primary bibliographic entry see Field 6E.
W82-04224

RENOVATION OF WATER MAINS AND SEWERS,
Newcastle and Gateshead Water Co. (England).
For primary bibliographic entry see Field 5F.
W82-04237

6D. Water Demand

WATERING AUSTRALIA'S DRIEST STATE,
University of Strathclyde, Glasgow (Scotland).
K. Smith.
Water Services, Vol 84, No 1008, p S5-S8, S13, February, 1980. 8 Fig.

Descriptors: *Water resources development, Water conveyance, Planning, Water supply, Water supply development, Watersheds, *Australia, Arid lands, Water management, Groundwater availability.

South Australia faces many challenging water problems, but has considerable potential for conservation by changing consumer habits. Such changes may be achieved in part by pricing policies, but over the long term, public education offers the greatest promise. With an informed public, it is possible to look forward to a continuing program of community involvement whereby the water supplier enters into a reciprocal relationship with the consumer in order to conserved resources for the benefit of all. In order to optimize all the local climatic and hydrological conditions, a wide variety of water sources is employed in South Australia. Most extensive use is made of groundwater, which occurs in a number of large sedimentary basins underlying rougly two-thirds of the State as well as in fractured rocks within the Mount Lofty and Flinders Ranges. There are probably more than 100,000 bores withdrawing in excess of 300,000 megaliters of groundwater per year. The first major water scheme was the construction of Beetaloo dam in the lower Flinders Ranges in 1890 to supply towns and firms between Port Pirie in the north and Ardrossan in the south. (Baker-FRC)
W82-03767

AGRICULTURE IN THE WIDER CARIBBEAN,
University of the West Indies, St. Augustine (Trinidad). Dept. of Soil Science.
F. Gumbs.
Ambio, Vol 10, No 6, p 335-339, 1981. 3 Tab, 8 Ref.

Descriptors: *Water supply, *Water demand, *Caribbean, Farming, Forestry, Rainfall, Agriculture, Water shortage, Irrigation, Water supply development, *Developing countries.

In general the agricultural production of the Caribbean region is inadequate to feed the population. The major interrelated problems concerning the use of water resources are location, annual distribution, and the cost of infrastructural development. While the region does possess sufficient water resources to cover its needs, the location is very often remote from where it is most required. The overwhelming majority of fresh water discharged to the sea is carried by comparatively few rivers remote from much of the agricultural and other human activities which need it. The uneven distribution of rainfall throughout the year is another major constraint relating to its use for agricultural and other purposes. Interference with or destruction of the forest in the watershed areas has served to intensify the water problem in many parts of the region, since many streams and small rivers which used to maintain satisfactory flows suitable for small-scale irrigation now virtually disappear during the dry season. Only small areas of agricultural lands in the region are irrigated. (Baker-FRC)
W82-03778

ENVIRONMENT AND PUBLIC HEALTH IN THE CARIBBEAN,
Pan American Health Organization, Washington, DC.
R. Reid.
Ambio, Vol 10, No 6, p 312-317, 1981. 2 Fig, 2 Tab, 18 Ref.

Descriptors: *Public health, *Developing countries, *Caribbean, Environmental effects, Waste disposal, *Wastewater treatment, Regional development, Drinking water, Water supply, Water quality, *Water demand, Urban areas, Rural areas.

Diseases linked to unsanitary conditions figure among the five leading causes of death in the Caribbean. Great emphasis is placed on such environmental services as water supplies, sewage, and solid waste disposal. There is also a growing awareness of pollution control and occupational health needs. Diarrheal diseases include specific infectious diseases in which water and food contamination play a major role, such as shigellosis, salmonellosis, and amebiasis. The major thrust of the water development program in these areas has been and still is directed at providing adequate urban water supplies, but considerable attention was also directed toward small towns and rural communities. The process of seeking external financing has contributed considerably to the improvement of administration, as many water utilities were poorly organized and did not observe the basic principles of management. Urban sewage services have failed to keep pace with the gains made in water supply and quality. None of the countries, with the exception of Panama, has made any significant progress in the field. The growing problem of adequately disposing of waste in order to avoid pollution of rivers and beaches is closely associated with the provision of sanitary sewers in urban areas. The analysis of data shows that the management of solid waste lags behind all other public services. Administration is generally deficient, collection and disposal unsatisfactory, and most personnel are untrained. (Baker-FRC)
W82-03787

AN ANALYSIS OF THE EFFECTS OF ALTERNATIVE MEASURES OF PRICE ON THE DEMAND FOR WATER BY SELF-SUPPLIED INDUSTRIES,
Arkansas Univ., Fayetteville.
For primary bibliographic entry see Field 6C.
W82-03828

GROUND-LEVEL VERSUS ELEVATED STORAGE,
Fort Wayne Water Utility, IN.
For primary bibliographic entry see Field 5F.
W82-03865

THE DEVELOPMENT OF WATER SUPPLY IN INDONESIA AND ALL ITS CHALLENGES.
Aqua, No 6, p 26-30, 32-33, 1981. 2 Tab.

Descriptors: *Water supply development, *Planning, *Indonesia, Water supply, Resources development, Urban areas, Rural areas, Human diseases, Public health.

Indonesia has a population of about 140 million as of 1980, with about 20% living in the cities and 80% in the rural areas. About 63.86% of the total population is settled on the island of Java, which covers an area of only 6.65%, bringing about a multitude of problems. Population growth rate is high, necessitating ways of increasing the drinking water supply. Water supply demands are also expected to increase substantially to cope with industrial development, expanded trade activities and urban development. For the most part drinking water supply facilities were built prior to World War II. No adequate attention has been given to the system since that time. The inadequacy of the sewerage system is also a problem, along with water pollution problems created by industrial and various other wastes, all of which pose a very serious threat to the water sources for the supply of drinking water. Improvements in rural water supply should first be carried out in areas where drinking water is scarce and the morbidity rate from cholera and other gastric disorders is high. REPELITA III, a plan to improve water conditions, calls for the building of 260,000 hand pump water wells, 12,000 water pipes, 300 artesian wells, 2,160 water source protection devices and installations and 3,500 rain water reservoirs. Urban water supply development programs will concentrate on improving water supply to low income groupings, densely populated areas, and in areas prone to disease. Problems of organization are considered, and the role of the Indonesian Water Supply Association is defined. (Baker-FRC)
W82-03868

HOUSEHOLD WATER USE: TECHNOLOGICAL SHIFTS AND CONSERVATION IMPLICATIONS,
Indiana State Budget Agency. Indianapolis.
For primary bibliographic entry see Field 3D.
W82-03910

INSTITUTIONAL ANALYSIS CRITERIA FOR WATER SUPPLY PLANNING,
Mathematical Sciences Northwest, Inc., Bellevue, WA.
G. R. Minton, R. Williams, and T. Murdock.
Water Resources Bulletin, Vol 16, No 3, p 486-493, June, 1980. 2 Fig, 2 Tab, 25 Ref.

Descriptors: *Water supply, Utilities, Institutions, *Planning, *Anchorage, *Water demand, *Alaska, Water resources, Municipal water, Water distribution, Evaluation, Alternative planning, Urban planning.

This paper discusses the criteria selected for evaluation of water institutions in the 1884 sq mi Anchorage, Alaska, region, which is rapidly approaching the limits of its natural water supplies. Each of the 15 water supply-related institutions were evaluated according to the following: public acceptability, political feasibility, adequate legal authority, adequate financial resources, fairness and equitability, technical capabilities, stability/reliability/flexibility, conservation suitability, efficiency, and enforcement authority. Additional factors considered were water rights, financing, physical limitations of a system, and land ownership status. Five alternative institutional arrangements were developed for the planning period. Although any of the arrangements could supply water needs, the most feasible one involved a water development agency within the municipality to be responsible for surface and groundwater sources. Area utilities would gradually be consolidated into the metropolitan water utility, responsible for distribution. Private utilities could buy water wholesale from the agency. (Cassar-FRC)
W82-03930

AN ECONOMIC EVALUATION OF INTERBASIN WATER TRANSFERS: A CASE STUDY OF SOUTHWESTERN CONNECTICUT,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 6B.
W82-03944

THE COST OF PEAK CAPACITY WATER,
Calgary Univ. (Alberta). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6B.
W82-04065

ENERGY AND WATER RESOURCES.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV/10154-4, Price codes: 15 in paper copy, A01 in microfiche. Department of Energy Report DOE/EV/10154-4, December, 1981. 331 p, 61 Fig, 140 Tab, 118 Ref. AC02-81EV10154.

Descriptors: *Energy, *Water supply, *Water quality, Water resources development, *Water management, Water use, Resources development, Mining, Industrial water, Institutions, Consumptive use, Cooling water, Water pollution.

The pursuit of energy independence has caused heightened concerns over potential conflicts with environmental quality and resource use. Water is used to a greater or lesser extent in most elements of energy development; water is affected by mining operations, energy processing and most other aspects of energy development and utilization. Sufficient water appears to be physically available to meet the needs of both energy and non-energy activities in society for at least the mid-term future, provided that proper care is taken in mananging this vital resource and in developing the institutional cooperation necessary. Three basic water-energy areas are considered: water quality, water supply; and their institutional framework. Water consumption by energy was 3% of the US total consumption in 1975, and is projected to rise to 6% by 2000. Cooling for thermal electric plants typically makes the heaviest consumptive water demands; process water and other requirements usually make lesser demands and may compete with non-energy uses for water. Water pollution problems may be started or made more severe by such energy-related activities as: surface disturbances; mine drainage; run-off and leaching from waste disposal areas; wastewater discharge; temperature increases from blowdown water; and decreased flow below minimum instream flow requirements. (Moore-SRC)
W82-04066

WATER USE IN MANUFACTURING.
1977 Census of Manufactures, Subject Series MC77-SR-8, August, 1981. 155 p, 30 Tab, 4 Append.

Descriptors: *Water use, *Consumptive use, *Industrial water, Oil industry, Pulp and paper products, Chemical industry, *Surveys, Spatial distribution, Steel industry, United States.

In the 1977 Census of Manufactures, approximately 16,200 establishments indicated the use of 20 million gallons or more of water in 1977. These large water users were included in the mailing of the special water use survey for 1978. Detailed information was reported by 9,605. According to the survey, establishments with an annual water intake of 20 million gallons of water or more accounted for about 95% of water withdrawn for manufacturing purposes. These plants represent only about 3% of the total number of manufacturing establishments and employ about 34% of the total number of persons engaged in manufacturing within the major groups covered. Approximately 84% of the 13.0 trillion gallons used by manufacturing establishments in 1978 was accounted for by four SIC (Standard Industrial Classification) major industry groups; Major Group 33, Primary Metal Industries; Major Group 28, Chemicals and Allied Products; Major Group 26, Paper and Allied Products; and Major Group 29, Petroleum and Coal Products. Even within these major groups, specific industries accounted for the major share; blast furnaces and steel mills, about 21%, and manufacturers of industrial organic chemicals, about 17% of the total. About 76% of industrial water use used by establishments located in six water use regions: the Great Lakes, the Ohio River, the Middle Atlantic, the Texas Gulf, the Lower Mississippe, and the South Atlantic. While the quantity of water intake by manufacturing establishments is relatively large, the quantities actually consumed is only about 10% of the withdrawals. (Moore-SRC)
W82-04070

FINAL ENVIRONMENTAL IMPACT STATEMENT: CHEYENNE STAGE II WATER DIVERSION, MEDICINE BOW NATIONAL FOREST.
Rocky Mountain Forest and Range Experiment Station, Laramie, WY. Forest Range and Watershed Lab.
May, 1981. 396 p, 11 Fig, 33 Tab, 71 Ref, 5 Append.

Descriptors: *Environmental impact statement, *Water supply development, *Water conveyance, *Environmental effects, Water resources development, *Water conservation, Municipal water, Reservoirs, Habitats, Fish, *Water demand, Dam safety, Salinity, *Cheyenne, Wyoming.

Because of expanding energy development in Wyoming, the capitol city of Cheyenne has foreseen a considerable increase in population, which would put demands on the municipal water system in excess of present supply. The Cheyenne Board of Public Utilities proposes to expand the water collection area in the Sierra Madre Mountains; increase the capacity of Hog Park and Rob Roy Reservoirs; collect water out of Douglas Creek and Lake Creek drainages; and install pipe for collection and transmission of water. Alternatives evaluated include: Alternative A (no action), Alternative B (Cheyenne Board of Public Utility proposed facilities with modification), Alternative C which is the preferred alternative (modify Stage I collection system to increase capacity), Alternative D (construct a lower reservoir in the North Fork of the Little Snake River and pump water into the existing sytem) and Alternative E (combine water conservation, agriculture water right purchase and groundwater development.) The following public issues were identified: alternative water sources; stream flows; reservoir fluctuations; Colorado River salinity; new access into unroaded areas; fish habitat; downstream water users; threatened or endangered species; terrestrial wildlife impacts; water supplies to other communities; reservoir safety; allocated water; and water conservation. (Moore-SRC)
W82-04073

ANALYZING THE RISK OF DROUGHT: THE OCCOQUAN EXPERIENCE,
Interstate Commission on the Potomac River Basin, Rockville, MD.
For primary bibliographic entry see Field 2A.
W82-04097

HOW MUCH WATER SUPPLY CAPACITY IS ENOUGH,
Johns Hopkins Univ., Baltimore, MD.
J. J. Boland, P. H. Carver, and C.. R. Flynn.
Journal of the American Water Works Association, Vol 72, No 7, p 368-374, 1980. 3 Fig, 6 Tab, 13 Ref.

Descriptors: Risks, *Model studies, *Water supply development, Prediction, *Water supply, *Water demand, Future planning, Water resources development, Water deficit, Water requirements, Forecasting, Projections, Water use, Reservoir storage, Water management, *District of Columbia area.

Because of concern about shortages in the Washington Surburban Sanitary Commission in July of 1974, the Bloomington Dam and reservoir project was authorized to provide an additional 135 mgd to the low flow of the river. The Bi-County Water Supply Task Force was created to study the alternatives to the building of pipelines from the Potomac plant to Triadelphia reservoir and to formulate water use restrictions during shortages. To project water use, regression analysis was performed using information from monthly billings. Results were used to form forecasting models. The calculation of water deficits involved the use of such data as historical monthly supply, simulated monthly water use and surplus-deficit, and weather and streamflow data. To decide if the probabilities of various water deficits would warrant increased storage, the effectiveness of water use restrictions was estimated, four scenarios of proposed effects of imposing these restrictions were created, and the amount of stored water needed in each future year to maintain each scenario was calculated. These studies allowed the specific supply projects required by each scenario to be determined. The task force decided to proceed with the design and construction of a small natural fill reservoir while designing and acquiring the land for a cross-country pipeline in accordance with a moderate deficit risk scenario. (Geiger-FRC)
W82-04103

WATER REQUIREMENTS FOR INDUSTRIAL DEVELOPMENT,
Department of Commerce, Washington, DC.
K. L. Kollar, and P. MacAuley.
Journal of the American Water Works Association, Vol 71, No 1, p 2-9, January, 1980. 2 Fig, 8 Tab.

Descriptors: *Water requirements, *Industrial development, *Employment, Planning, *Water demand, Industrial water, Water use, Water supply, Water shortage, Water reuse, Economic development, Long-term planning, Short-term planning.

Availability of water should be considered in planning industrial sites. Tables relating water use to productivity and employment in various industries are presented. Greatest water supply and demand problems are in the Great Plains and Southwest. The Lake Superior region has a shortage of quality water but ample industrial grade cooling water. Saltwater intrusion is a problem in many coastal regions. Mississippi River water is suitable for cooling water. The islands of Hawaii, Virgin Islands, and Puerto Rico have limited fresh water supplies. The following tables are given: water use

(noncontact cooling, process, and sanitary) for 34 industries, water use per employee for 20 industries, water use vs. industrial units and standardized units of production of 34 industries, water use in paper mills, and water intake requirements of 34 industries without and with maximum possible recycling. Water shortages are predicted for the Southwest and the Sunbelt, as heavy water-using industries are increasingly locating there. (Cassar-FRC)
W82-04117

REEVALUATING HUNTER'S MODEL FOR RESIDENTIAL WATER DEMAND,
Stevens Inst. of Tech., Hoboken, NJ.
W-Y. Chan, and L. K. Wang.
Journal of the American Water Works Association, Vol 72, No 8, p 446-449, 1980. 5 Fig, 1 Tab, 4 Ref.

Descriptors: *Water demand, *Model studies, Mathematical models, Hunter's model, Water supply development, *Water supply, Economic aspects, Design criteria, Probability distribution.

The frequency and duration of water usage at various domestic fixtures were originally evaluated by Hunter, and more recently were reevaluated, since Hunter's estimates have been regarded as too high. It is felt that use of Hunter's model may lead to oversizing of water supply piping. In applying probability theory to estimate the demand load, Hunter determined the number of fixtures to be operated simultaneously at any point in time. His procedure requires information on the frequency of use of each fixture, the operating time of a fixture and the volume of water consumed per use. Actual data on the use of water fixtures were gathered from the married student's dormitory on the Stevens College campus. There are several possible approaches to the development of sizing procedures. The least expensive one requires instrumentation of buildings to permit the parameters applicable to Hunter's model to be determined. Each individual fixture within a building would have to be monitored over a period of time. The data acquisition equipment to record the on-off signals as a function of time would also have to be installed. By knowing how much water was used per capita per day, where it was used, and when, researchers would be able to suggest methods of improving design techniques for estimating demand. More data are needed to provide a wider range of frequency of use and to improve the Hunter model used for water supply systems. (Baker-FRC)
W82-04131

FORECASTING WATER DEMAND IN THE PACIFIC NORTHWEST,
URS Co., Seattle, CO.
D. W. Browne, G. Minton, and C. Barnhill.
Journal of the American Water Works Association, Vol 72, No 9, p 506-507, 1980. 1 Fig.

Descriptors: *Water use, *Water management, *Water demand, Mathematical studies, Urban areas, Metropolitan water management, Rural areas, *Pacific Northwest, Projections.

Recent trends in per capita water consumption in the Pacific Northwest are examined. Material is drawn from a recently completed regional water supply conducted as part of the US Army Corps of Engineers Portland-Vancouver metropolitan area water resources study. A general leveling or decrease in the average rate of per capita consumption was noted over the last decade. Variation in the weather from year to year is the most obvious possible reason for annual variations in per capita consumption. However, in this report the data indicate other factors were in the main responsible. One factor may be the generally increased public awareness of the need to conserve water and other resources by avoiding wasteful practices. Recent federal regulations requiring industries to assume a greater responsibility in the area of costs of treating industrial wastewater discharged to municipal sewers have lowered per capita use through the development of water reuse techniques. It is expected that the trend toward lowered per capita water use will continue, particularly in areas where industry is a significant water user or where the percentage of multifamily housing is increased at a significant rate. Rural areas being converted to upper middle class suburbs will probably see consumption remain level or increase. Water demand for municipal large metropolitan areas should be forecast using a more sophisticated method of evaluation than simply population times a composite historical consumption value. Monitoring consumption will reveal valuable information regarding trends in service area water consumption. (Baker-FRC)
W82-04135

DENVER'S POTABLE REUSE PROJECT: PATHWAY TO PUBLIC ACCEPTANCE,
Denver Water Dept., CO
For primary bibliographic entry see Field 3C.
W82-04140

CAN PRICES TAME THE INFLATIONARY TIGER,
Montana State Univ., Bozeman. Dept. of Agricultural Economics.
B. R. Beattie, and H. S. Foster, Jr.
Journal of the American Water Works Association, Vol 72, No 8, p 441-445, 1980. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Water costs, *Metropolitan water management, *User charges, Pricing, Water management, Economic aspects, *Water demand.

This paper discusses the need for water by the urban residential sector as revealed by its economic demand. An elementary review of the notion of economic demand is followed by empirical results from a nationwide study of regional residential water demand. The paper concludes with a discussion of implications for assessing how much water is needed and what has happened to residential water prices in the United States in nominal (actual dollar) and real (constant dollar) terms. Determining needs is one of the basic functions of an economic system. Additionally, it is widely believed by economists that a consumer's willingness to pay for a particular commodity generally tends to decline as increasing quantities of that commodity are obtained. A homeowner's willingness to pay for water for horticultural purposes diminishes as increasing quantities are obtained. Consumer needs might change in response to changing economic conditions, and it is important to distinguish between nominal and real dollars. Just as decreasing real water prices have served to increase the demand for water, increasing real prices will serve to decrease that demand. In the absence of a government edict to ration, restrict, or control water use, or an educational program to alter consumers' tastes and preferences, price is the only tool available to regulate demand. The choice is largely up to the water utility industry. (Baker-FRC)
W82-04142

WATER CONSTRAINTS ON EMERGING ENERGY PRODUCTION,
Aerospace Corp., Germantown, MD.
N. F. Hampton, and B. Y. Ryan, Jr.
Water Resources Bulletin, Vol 16, No 3, p 508-513, June, 1980. 3 Fig, 4 Tab, 7 Ref.

Descriptors: *Energy sources, *Water requirements, *Institutional constraints, *Water demand, Groundwater pollution, Water use, Water consumption, Planing, Water supply, Water law, Water quality, Water shortage, Nuclear energy, Coal gasification, Oil shale, Geothermal power, Solar energy.

Water requirements of major energy technologies are summarized for the years 1985 and 2000. These range up to 3079 mgd (1985) and 13,407 mgd (2000) for nuclear electric plants. Fossil-fired power plants and oil extraction will also be heavy users in 1985. Geothermal electric generation will increase to 2842 mgd by 2000. Consumption levels by energy and nonenergy uses are listed for 21 geographic regions in the U.S. Regions with water supplies inadequate for 2000 are identified. Most of these, except for south Florida, are in the southern two-thirds of the area west of the Mississippi. Some of these regions include known rich, undeveloped fossil energy supplies. Water quality problems will be manageable with existing technology. The most likely pollutants connected with energy development are phenol, ammonia, cyanide, sulfur, chloride, and dissolved solids. Institutional constraints, listed in a table, may play a role in energy development, primarily as a delaying effect. (Cassar-FRC)
W82-04151

DUAL DISTRIBUTION SYSTEM SOLVES PELICAN BAY'S WATER SUPPLY PROBLEMS,
Post, Buckley, Schuh, and Jernigan, Inc., Fort Myers, FL.
For primary bibliographic entry see Field 5F.
W82-04193

SIZING AND SELECTING MODERN WATER METERS,
E. Seruga.
Water/Engineering and Management, Vol 129, No 1, p 40-42, January, 1982. 2 Tab.

Descriptors: *Water metering, *Measuring instruments, Water measurement, *Cost-benefit analysis, Meter types, Comparison analysis.

Selection of the proper water meter for the job involves the choice of both size and type of meter. Too often meter size is chosen merely to match the pipe diameter without recognizing that oversized pipe may have been used to allow for possible growth in water use or to reduce pressure loss in a long stretch of pipe. Selection should be based only on the flow requirement and the kind of application, not on pressure loss through the meter. Traditionally the positive dislacement disc or piston-type meters have been most widely used, since they are well suited to residential and other applications where there are relatively long periods of the day during which no water is used. Current meters and propeller meters are normally used when there is no real concern about low flow metering due to large volumes of water being used. Compound meters are a combination of the positive displacement and current-type meters. Applications for turbine meters can now be expanded to cover a wider range of installations. Through extended use of this meter type one can obtain sensitivity at low flow rates with excellent accuracy at the high end of the flow range. Typical recommended uses for each type of meter classification are tabulated. (Baker-FRC)
W82-04194

FUTURE DIRECTIONS IN FEDERAL WATER RESOURCES,
Office of the Assistant Secretary for Civil Works, Washington, DC.
W. R. Gianelli.
Water/Engineering and Management, Vol 129, No 1, p 12, January, 1982.

Descriptors: *Water resources development, *Federal jurisdiction, Water supply development, Resources development, *Regulations, Economic aspects, Government supports, *Economic development.

The principal task of the Working Group established from the Cabinet Council on Natural Resources and Environment has been to review the Principles and Standards for Water Resources Planning. A fundamental new direction follows from the Cabinet Council's affirmation that the paramount objective which should guide the formulation of new water resources projects is the objective of national economic development. National economic development, as opposed to regional or local economic development or enhancement of environmental values, should be the principal guide under which the benefits and costs of a proposal should be considered. State and local concerns also merit consideration, especially when water project features to meet these concerns can be fully paid for by the benefiting non-federal

intersts. The administration has the opportunity and responsibility to seek and to support sensible non-federal financing which will relieve the burden on the federal budget. (Baker-FRC)
W82-04196

PUBLIC ATTITUDES IN MASSACHUSETTS TOWARD THE RECREATIONAL USE OF DOMESTIC WATER SUPPLY RESERVOIRS,
University of Southern Mississippi, Hattiesburg. Dept. of Recreation.
W. H. Bumgardner, L. R. Klar, and A. Ghirin.
Water Resources Bulletin, Vol 16, No 2, p 279-284, April, 1980. 4 Tab, 7 Ref. OWRT A-107-MASS.

Descriptors: *Recreation, *Public opinion, *Reservoirs, Water demand, Water use, Legal aspects, Legislation, Surveys, Water pollution sources, Swimming, Fishing, Boating, Water quality, *Quabbin Reservation, Massachusetts.

This paper reports the results of two integrated studies of recreation users of Quabbin Reservation, the largest inland water source in New England, and the general public of Massachusetts, regarding the extent to which public drinking water reservoirs should be used for recreational purposes. On-site interviews were used to gather the data, along with state-wide telephone interviews of the general public. Results of the study indicated that the majority of Massachusetts residents do not favor recreational-prohibiting laws for most activities. At least moderate use of the reservoirs for recreational purposes was favored by the majority. Overall views were not as restrictive as present legislation would suggest. The current recreation prohibiting laws should probably be reassessed in light of public opinion. Activities receiving the strongest support were generally passive in nature, including photography, nature study, and sight-seeing. However, snowshoeing, skiing, horseback riding, and ice-fishing were supported by the interviews. Only six activities were not viewed favorably: snowmobiling, motorcycling, hunting, swimming, motorboating, and water skiing. (Baker-FRC)
W82-04222

PEAK PERIOD DESIGN STANDARDS FOR SMALL WESTERN U.S. WATER SUPPLY SYSTEMS,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
T. C. Hughes.
Water Resources Bulletin, Vol 16, No 4, p 661-667, August, 1980. 8 Fig, 3 Tab, 4 Ref.

Descriptors: *Peak demand, *Water demand, *Design criteria, Municipal water, *Utah, *Colorado, Water price, Prices, Water use, Water requirements, Arid climates, Irrigation, Landscaping, Lawns.

Multiple regression and frequency analysis of water demand parameters for 14 systems in semiarid Colorado and Utah were done for the purpose of improving accuracy of design capacity estimates. Parameters were average month, peak month, and peak day water requirements. Design criteria dependent on these parameters are water rights, reservoir storage, and pump or treatment plant size. Independent variables significant for monthly and daily demands were water price and outdoor use index. The outdoor use index ranged from 1 to 9 (from no outdoor use from a domestic system to a large amount of landscaping in a hot dry climate requiring all watering from the domestic system). Design levels should be 25% above expected for average demand, 20% above expected for peak month, and 20% above expected for peak day. Comparisons with textbook peak day estimates, probably developed for the eastern U.S., showed that 5 out of 7 were too low for use in the arid climate of Utah. (Cassar-FRC)
W82-04249

6E. Water Law and Institutions

ENVIRONMENTAL ASPECTS OF WATER-RESOURCES PLANNING IN ENGLAND AND WALES,
Department of the Environment, Reading (England). Central Water Planning Unit.
L. E. Taylor.
Journal of Hydrology, Vol 51, No 1-4, p 232-243, May, 1981. 2 Fig, 25 Ref.

Descriptors: *Environmental effects, *Water resources development, *Planning, Regional planning, Management planning, Environmental protection, River basin development, Interbasin transfers, Estuaries, Wales, *Great Britain, England, Water Resources Act.

The Water Resources Act of 1963 provides the framework for the comprehensive management of water resources in England and Wales. This paper discusses the resultant management procedures which have facilitated consideration of regional schemes including river regulation, inter-river transfers, and freshwater storage in estuaries. The environmental aspects of these representative regional schemes are discussed with particular reference to a feasibility study of freshwater storage in the Wash. Multipurpose Regional Water Authorities created in 1974 consider water-resources schemes within a framework of priorities for other water services. While it is necessary to consult the public on alternative water strategies, it is also necessary to ensure that resources are developed in time to meet increasing demands. It is suggested that environmental evaluation of water schemes is more appropriate for England and Wales than formalized environmental impact assessment, which often results in the presentation of extensive data, some of which is subjective and much of which appears to be of doubtful use to planners. (Carroll-FRC)
W82-03806

A LEGAL-ECONOMIC CRITIQUE OF GROUNDWATER LAW AND ADMINISTRATION: WITH SPECIAL REFERENCE TO ARIZONA AND NEBRASKA,
Nebraska Univ., Lincoln.
D. C. Nelson.
PhD Thesis, July 1981. 315 p, 15 Fig, 6 Tab, 441 Ref, 11 Append, Footnotes, University Microfilms International, Ann Arbor, MI; Order No GAX81-22597.

Descriptors: *Groundwater management, *Economic aspects, *Legal aspects, Groundwater depletion, Groundwater mining, Water rights, State jurisdiction, *Arizona, *Nebraska.

The institutional framework for groundwater allocation should provide incentives for the efficient use of groundwater. In addition, groundwater rights should be allocated on an equitable basis. Some economic considerations for the efficient and equitable use of groundwater are discussed. Economic considerations reflect that higher valued uses can justify pumping costs that are much greater than lower valued uses can afford to pay. Also, some users for the same purpose can afford to pay more than others. This is particularly true in agriculture, where more efficient operators can afford to pay the costs of pumping from greater depths. Because groundwater is a common property resource, many conflicts arise when groundwater is used. Several types of externalities are described: (1) interference problems may occur if wells are located too close together; (2) groundwater in rechargeable aquifers may be pumped at rates in excess of their rates of replenishment, thus resulting in overdraft conditions; (3) non-recharging aquifers, which do not have any appreciable rate of recharge, are being mined when groundwater is pumped; (4) problems may result from either the transfer of groundwater rights or the transporting of groundwater away from the underlying aquifer; (5) disputes between streamwater users and groundwater users may arise if the two sources of water are interconnected; and (6) the quality of groundwater may deteriorate either with pumping or use of such waters. Various alternatives for resolving these externalities are presented. Arizona and Nebraska are experiencing increasing demands upon groundwater resources and reforms and innovations are needed to solve groundwater problems. (Sinha-OEIS)
W82-03827

EPA'S PRIORITY POLLUTANTS: WHERE THEY COME FROM--WHERE THEY'RE GOING,
Radian Corp., Austin, TX.
L. H. Keith.
AIChE Symposium Series, Vol 77, No 209, 1981. 6 Tab, 7 Ref.

Descriptors: *Pollutant identification, *Chemical analysis, *Organic compounds, Pollutants, Priority pollutants, Regulations, Legal aspects, Gas chromatography, *Pollution index, Federal regulations.

The history of the EPA's priority pollutant list is traced and future trends outlined. The Federal Water Pollution Control Act (1972) and sections of the Clean Water Act (1977) required the EPA to promulgate guidelines establishing test procedures for analyzing water pollutants. This resulted in the Toxic Pollutant list, 65 compounds and classes of compounds in 21 point-source industrial categories. From this group of thousands of potential compounds was developed a list of 129 Priority Pollutants, divided into 8 categories (purgeable, alkaline-extractable, acid-extractable, pesticides, total cyanides, total phenols, metals, and asbestos). Three phases of analysis were scheduled. The Screening Phase, now virtually complete, was designed to identify which of the priority pollutants are in the treated and untreated wastewaters of each of the 21 industrial categories. The Verification Phase, also nearing completion, determines the efficiencies of the treatment technologies under consideration. The final Monitoring phase will be compliance monitoring of discharge permits. Tables summarize the priority pollutants found in effluents from timber, pulp and paper, and gum and wood chemicals categories. Acceptable methods (gas chromatography-mass spectrometry, gas chromatography with selected detectors or high performance liquid chromatography) for analyzing each of the organic compounds are listed. At present, analytical methods are being improved. Trends are toward automation, cost reduction, mobile laboratories, and use of stable isotopically-labeled analogs as internal standards. The list of 129 priority pollutants may be expanded in the future. (Cassar-FRC)
W82-03875

NPDES COMPLIANCE FLOW MEASUREMENT MANUAL,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5D.
W82-03965

WASTE DISCHARGE MONITORING REQUIREMENTS UNDER THE NPDES PERMITS PROGRAM,
Systems Research Co., Philadelphia, PA.
For primary bibliographic entry see Field 5D.
W82-03969

INNOVATIVE/ALTERNATIVE TECHNOLOGY PROGRAM; CASE STUDIES,
For primary bibliographic entry see Field 5D.
W82-03970

THE CONTROL OF POLLUTION ACT 1974. 1. IMPLICATIONS FOR RIVER QUALITY MANAGEMENT,
Wessex Water Authority (England).
R. Robinson.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 2, p 129-144, March, 1980. 6 Tab, 7 Ref.

Descriptors: *Rivers, *Management planning, *Legal aspects, *Water pollution control, *Industrial wastes, Water treatment, Water quality, Water quality standards, Flow discharge, Cost analysis, Streams, Hydrologic data, Monitoring, Sewage treatment facilities, *United Kingdom.

The system for the control of water pollution in the United Kingdom is described. The major statutory powers for water pollution control in England and Wales are embodied in the Rivers Acts 1951-

61. Application of the provisions of these Acts has allowed gradual extension of the control of polluting discharges. River boards, authorities, and regional water authorities have successively been responsible for the administration of legislation and organizations have evolved, which have become more technically competent as both management and chemical science have developed. An attempt has been made to estimate the expenditure required to acheive long term sewage treatment objectives, based on projected weather conditions and design flows. The reorganization of the water industry and impending implementation of Part II of the 1974 Control of Pollution Act represent major changes in the organizational and legal frameworks for pollution control. (Titus-FRC)
W82-04088

THE IMPACT OF FEDERAL WATER POLICY ON STATE PLANNING: A CAUTIONARY EXAMPLE,
California Dept. of Water Resources, Sacramento.
R. B. Robie.
Journal of the American Water Works Association, Vol 72, No 2, p 70-73, February, 1980.

Descriptors: *Water policy, *State jurisdiction, *Federal jurisdiction, *Water law, *California, Interagency cooperation, Water resources development, Planning, Political aspects, Arid lands, Water demand, Water supply development, Reservoirs.

The conflicts between federal and state water policies are described using California as an example. This arid state differs from the average state because it has only 3% of the nation's renewable water supplies but has high agricultural demand. In the past, federal water resources development projects competed with state projects and were not built with consideration for environmental impacts. In 1975 the state developed a water policy relevant to California's situation and needs. Conflicts often arise between federal and state agencies with respect to reservoir releases, water quality, water rights, planing, and cost sharing. California has drafted amendments to the cost sharing bill. These involve more state participation in planning, more consideration of state water rights laws, contracts with users prior to begining a project, and state safety approval of dam sites. California and the federal government have also disagreed on the importance of instream uses, water conservation, and use of reclaimed water. It is suggested that the federal government accept the state water system law and increase involvement of local and state agencies in planning. (Cassar-FRC)
W82-04120

THE ECONOMIC EFFECTS OF CHANGES IN WATER USE IN THE TUCSON BASIN, ARIZONA,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
A. H. Griffin, J. C. Wade, and W. E. Martin.
Water Resources Bulletin, Vol 16, No 5, p 849-855, October, 1980. 1 Fig, 12 Ref.

Descriptors: *Water rights, *Groundwater management, *Available water, *Economic aspects, *Arizona, Legal aspects, Water shortage, Water deficit, Water costs, Water demand, Water supply, Water law, User charges, Consumptive use, Water use.

Because of the declining water table in the Tucson basin, many legal conflicts have arisen among the affected Arizona water users in this area. A lawsuit is in progress from the Papago Tribe against some of the major water users of the basin for pumping violations which infringe upon water rights implied during the establishment of the Indian reservation. The Arizona State Legislature has set up a commission to propose reforms for existing groundwater laws which may change water use in the basin. Some possible effects of decreased water availability on the state's economy are considered. Since agriculture is not a major contributor to the regions economy, decreased production due to irrigation cuts will have a negligible effect on prosperity. In the face of higher water costs or restrictions, copper mines can reduce their water consumption without affecting total output. It is expected that utilities will not pass on large cost increases to their customers in the face of water shortages because raw water makes up only a small part of the total cost of piped water in the area. (Geiger-FRC)
W82-04156

WHAT IS A POINT SOURCE,
Cook Coll., Brunswick, NJ.
W. Goldfarb.
Water Resources Bulletin, Vol 16, No 6, p 1108-1109, December, 1980.

Descriptors: *Nonpoint pollution sources, *Mine drainage, *Judicial decisions, Point source pollution, Water law, Water pollution sources, Legal aspects, Regulations.

Although mining operations were exempted from point source pollutant discharge requirements, two mining operations were ruled point source dischargers in recent court decisions. In the case of United States versus Earth Sciences, Inc., an outdoor gold leaching operation in Colorado was viewed as a closed circulating system (point source) which failed during a period of heavy snowmelt and caused a fish kill in the nearby creek. The Sierra Club v. Abston Construction Co., Inc., case concerned sediment pollution of a stream from erosion of piles of strip mine debris. The mine operators were judged guilty of pollution because the spoil piles were not properly designed to resist erosion from precipitation. (Cassar-FRC)
W82-04158

FUTURE DIRECTIONS IN FEDERAL WATER RESOURCES,
Office of the Assistant Secretary for Civil Works, Washington, DC.
For primary bibliographic entry see Field 6D.
W82-04196

PUEBLO INDIAN AGRICULTURE, IRRIGATION AND WATER RIGHTS,
Utah Univ., Salt Lake City. Dept. of History.
J. A. Vlasich.
PhD Thesis, June, 1980. 364 p, 8 Tab, 120 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-19421.

Descriptors: *Irrigation, *History, *Legal aspects, *Water rights, Agriculture, Land use, Water users, Conservation, *New Mexico, *Pueblo Indians.

A historical account is given of the use of irrigation water in agriculture in the arid southwest of the United States. In particular, the practices of the Pueblo Indians are described. Agriculture has been a major concern for the Pueblo Indians from time immemorial. It is an activity interwoven with the religion, government and very existence of the Pueblos. Today, agriculture is still important in the Pueblo economy, but it has been supplemented by ranching, crafts, and off-reservation employment. Early Spanish explorers who came into New Mexico noted the efficient irrigation canals and abundant crops of the Pueblos. Their reports encouraged Spanish settlers, who brought institutions, seeds and tools in order to transplant their own agricultural program. An important aspect of Spanish culture to be introduced in the New World was the legal system. Throughout the Spanish period, the Pueblos were involved in frequent litigations to protect their agricultural program. The Pueblos continued to solve water and land conflicts after the Mexican government was formed. Because of the large increase in the number of Hispanic and Anglo settlers along the Rio Grande, Pueblo rights were jeopardized and there was increased encroachment on Pueblo land. In 1924, the Pueblo Lands Act was passed and created the Lands Board which was designed to deal with trespassing on Indian Land. There was increasing awareness of the need for improving Indian agriculture. As a result numerous water development projects were started. The pressures of the Great Depression and World War II made Indians more willing to accept modernization. (Sinha-OEIS)
W82-04208

PROBLEMS OF PUBLIC ACCESS TO WATER IN TEXAS LAKES AND STREAMS,
Texas Tech Univ., Lubbock. Dept. of Geography.
O. W. Templer.
Water Resources Bulletin, Vol 16, No 4, p 668-675, August, 1980. 2 Fig, 42 Ref. OWRT A-042-TEX.

Descriptors: *Water law, *Riparian rights, *Public access. Recreation, *Texas, Navigable rivers, Lakes, Rivers, Streams, Legislation, Regulations, Public waters, Legal aspects, Property rights, Common law, Trespass, Right-of-way.

In Texas conflicts have arisen between owners of property along public waters and the public seeking recreational use of these lakes and streams. Since the appropriation statutes of the late 1800's were enacted, most surface waters have been owned by the state and held in trust for the benefit of the people. No laws give the public the right to use these waters, but there is conflicting case law granting access to navigable streams. However, laws specifically state that the public may not cross private property to reach public waters. Texas land grants with their attendant property rights originated under different laws during the Spanish, Mexican, Republic of Texas, and state periods of history. As a result, it is impossible to determine the laws on access without knowing the background of the particular property. Frequently, private fences across waterways and along shores impede the public access to water. The most numerous rights of way are at points where highways cross streams. Some limited information on public access is available in several publications, but none is comprehensive. Legislation, such as the Texas Public Rivers Act of 1973, intended to clarify this ambiguous situation, has been proposed several times in recent years, but active opposition from riparian landowners prevented passage. The most feasible solution for the present is to disseminate better information on the legal status of streams and access points to the recreational public. (Cassar-FRC)
W82-04220

CONJUNCTIVE MANAGEMENT OF WATER RESOURCES IN THE CONTEXT OF TEXAS WATER LAW,
Texas Tech Univ., Lubbock. Dept. of Geography.
O. W. Templer.
Water Resources Bulletin, Vol 16, No 2, p 305-311, April, 1980. 1 Fig, 43 Ref.

Descriptors: *Water rights, *Water management, Ground water, Water resources development, Legal aspects, Hydrologic cycle, *Texas, Conjunctive use, *Water law.

This paper examines the critical interaction between existing legal institutions and the state's water resources, especially as related to opportunities for conjunctive use and management of the water supply. Conjunctive use and management of interrelated water resources are generally considered desirable, though seldom practiced. The legal division of water in the various phases of the hydrologic cycle into different classes and recognition of well defined water rights in the separate phases are among the major barriers. Problems related to or resulting from present Texas water laws are discussed. Due to the large number of recognized private water rights and the political power inherent in them, any substantive revision of Texas law, particularly ground water law, will apparently be difficult to achieve in the immediate future. In the future other hydrologic phases may be integrated with surface and ground water through the acquisition of the data needed for operation of conjunctive management systems. At the present time Texas courts have sufficient information concerning interrelated hydrologic cycles so that prospective water conflicts should be anticipated and thus avoided. New types of private water rights or extensions of existing rights should be viewed with great care due to the fact that this institutional structure, once established, presents a

formidable obstacle to desirable revisions of the law. (Baker-FRC)
W82-04223

THEORY AND REALITY IN ALLOCATING FEDERAL RESOURCES TO WATER RESOURCES DEVELOPMENT,
George Washington Univ., Washington, DC. Dept. of Engineering Administration.
R. C. Waters.
Water Resources Bulletin, Vol 16, No 2, p 256-260, April, 1980. 2 Tab, 14 Ref.

Descriptors: *Water policy, *Water resources development, *Cost sharing, Cost-benefit analysis, Benefits, Investment, Financing, Political aspects, Planning, Local governments, State governments, Federal jurisdiction, Regulations, Economic development, Environmental quality, Economic aspects.

The economic theory and practice on which Federal water resources development is based results in overinvestment. Specific problems include: (1) no standard of value for the tradeoff of environmental objectives with economic objectives, (2) benefits based on willingness to pay where the beneficiaries pay only part of the project's costs, (3) beneficiaries reduce their commitments by selecting among various program purposes, (4) benefit-cost analyses based on a discount rate lower than the Federal borrowing rate, and (5) inconsistent and questionable benefit calculations. Federal water resources plans are generally initiated by private citizens. Requirements for planning procedures include the objectives of national economic development and environmental quality and account for the effects on regional economic development and social well being. Non-Federal groups (beneficiaries, state and local governments, and public utilities) contribute an average of 30% of the value of Federal water resources development projects. The President has proposed water policy reforms which will reduce overinvestment. These reforms include a planning manual to make the procedures more consistent, an independent impartial review of the projects by the Water Resources Council, state participation in financing, and cost sharing in flood control projects. The Congress, responsible for enacting these suggestions, has thus far resisted such efforts to reduce overinvestment. (Cassar-FRC)
W82-04224

INTERNATIONAL DECADE ON DRINKING WATER AND SANITATION,
Bureau of International Organization Affairs, Washington, DC.
J. W. McDonald, Jr.
Water Resources Bulletin, Vol 16, No 2, p 356-358, April, 1980.

Descriptors: *Drinking water, *Sanitation, *Public health, *United Nations, Planning, Water policy, International Decade on Drinking Water and Sanitation, Water resources development, Water supply, *Developing countries.

The U.N.'s designation of the 1980's as the Decade for Drinking Water and Sanitation was an outgrowth of the March 1977 U.N. Water Conference and the June 1970 U.N. conference on Human Settlements, which concluded that 2/3 of the developing world did not have reasonable access to safe drinking water and that an even larger portion did not practice hygienic disposal of human waste. Since that time four U.N. bodies have passed resolutions supporting this Decade. To help meet the goals for safe drinking water and hygienic waste disposal for the world's population by 1990, the U.S. government, through the Agency for International Development, is presently supporting 70 Decade-related projects in 33 countries, with plans to increase to 136 projects in 73 countries in 1981. Further help is needed from the private sector and member states of the OECD. Commitment to the project's goals may be summarized by the four M's: motivation, manpower, management, and money. (Cassar-FRC)
W82-04230

FEDERAL SUBSIDY OF IRRIGATION DEVELOPMENT,
Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economics.
J. B. Wyckoff.
Water Resources Bulletin, Vol 16, No 2, p 312-316, April, 1980. 1 Tab, 9 Ref.

Descriptors: *Federal jurisdiction, *Irrigation programs, Farming, Irrigation, *Government supports, Economic aspects, Subsidies, Land management.

Federal subsidies have been involved in the development of irrigation programs in the western states. However, the total amount of the subsidies involved is insignificant compared to the total Federal budget and the size of subsidies under other subsidy programs. The principal question pertains to the distribution of the subsidies and a desire for land reform among certain elements of the population. If land reform is the issue, the policy should be national and all agricultural land should be involved, rather than merely land under Federal irrigation projects. Such a national policy has not yet been seriously considered. The importance of irrigation on the public lands has been noted since the enactment of the Carey Act of 1884, and was reinforced with the passage in 1902 of an act appropriating the receipts from the sale and disposal of public lands in certain states and territories to the construction of irrigation works for the reclamation of arid lands. Land so irrigated would then be entered under the provisions of the Homestead Laws and lawsuits have upheld this provision and required landowners receiving Federal subsidies through irrigation projects to sell off land in excess of 160 acres. (Baker-FRC)
W82-04233

6F. Nonstructural Alternatives

FLOODPLAIN MANAGEMENT NEEDS PECULIAR TO ARID CLIMATES,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 2E.
W82-03908

UTILIZATION, PLANNING AND PROBLEM EVALUATION OF URBAN ARTERIAL WATERWAYS AND CORRIDORS AS AN URBAN RESOURCE,
Oklahoma Univ., Norman. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-03952

STATE AND LOCAL ACQUISITION OF FLOODPLAINS AND WETLANDS; A HANDBOOK ON THE USE OF ACQUISITION IN FLOODPLAIN MANAGEMENT.
Water Resources Council, Washington, DC.
Water Resources Council, Washington, D.C., September, 1981. 141 p, 10 Fig, 101 Ref.

Descriptors: *Flood plain management, *Wetlands, *Land acquisition, *Economic aspects, Relocation, Community development, Land use, Market value, Flood damage, Local governments, Organizations, Handbooks.

Acquisition of floodplains and wetlands can be useful and effective method of reducing flood losses and protecting natural values. However, it is often most effective when used in combination with other floodplain management tools, or in conjunction with other community development or redevelopment programs. Acquisition programs require some of all of the following steps: selecting properties and setting priorities: reserving properties; determining how properties will be acquired; obtaining funds; acquiring properties; providing relocation assistance; property clearance and management. Paying fair market value can be a costly way to acquire property. A community may be able to reduce its costs through a variety of methods while still obtaining necessary control of the land: acquisition at less than fair market value; acquisition through donation or device; leases; easements; subdivision dedication requirements; and transfer of development rights. Lack of funds and lack of technical assistance are the most common impediments to acquisition. In a time of shrinking government budgets, state and local officials may find private sources an increasingly important contribution to acquisition of floodplains and wetlands. Conservation organizations have proven to be particularly beneficial because of their flexibility in conducting land transfers to supplement government acquisitions and to accept land when government units are unwilling or unable to do so, or where property owners prefer not to deal with a government agency. (Moore-SRC)
W82-03966

FLOODPLAIN DELINEATION: AN ECONOMIC APPROACH,
Colorado Univ. at Denver. Dept. of Civil and Urban Engineering.
W. C. Hughes.
Water Resources Bulletin, Vol 16, No 2, p 267-270, April, 1980. 1 Fig, 6 Ref.

Descriptors: *Flood plain zoning, *Mapping, *Economic aspects, Hydrologic maps, Maps, Hydrology.

Errors inherent in the computation of water surface profiles are magnified by the shallow lateral slopes typical of many river valleys, often producing floodplain boundary errors several hundred feet wide. Hydrologic methods yield only a first approximation with respect to the location of a floodplain boundary. Economic optimization techniques which weigh the costs of overstating the location of the floodplain boundary against the costs of understanding its location provide a means to refine the hydrologic first approximation by establishing the economically optimum location for the floodplain boundary within the boundary error zone. Unless the flood damage costs associated with understating the boundary location exceed the cost of overstating the boundary position by at least one order of magnitude, the floodplain boundary will coincide with the minimum probable water surface profile. This would imply that in the absence of an error evaluation and economic analysis, the least conservative assumptions should be used to establish a floodplain boundary. (Baker-FRC)
W82-04236

6G. Ecologic Impact Of Water Development

RESERVOIRS AND THE TRIGGERING OF EARTHQUAKES,
Open Univ., Milton Keynes (England). Dept. of Earth Sciences.
For primary bibliographic entry see Field 8A.
W82-03766

PANOCHE CREEK FLOOD PROTECTION WORKS,
Bureau of Reclamation, Sacramento, CA.
For primary bibliographic entry see Field 4A.
W82-04068

SAN FRANCISCO RIVER WILD AND SCENIC RIVER STUDY REPORT; GREENLEE COUNTY, ARIZONA.
Apache Sitgreaves National Forests, Springerville, AZ.
April, 1981. 158 p, 25 Fig, 12 Tab, 1 Append.

Descriptors: *Environmental impact statement, *Wild rivers, *Public opinion, *Water resources development, Recreation, Water quality, Wildness areas, Scenery, Environmental effects, Resources development, Land use, San Francisco River, Greenlee County, *Arizona.

Segments of the San Francisco River were evaluated to determine whether they qualify for designation as a wild, scenic, or recreational river. The study segments of the river lie entirely within

Greenlee County, Arizona. The five alternatives considered are: 1, no designation and no action; Alternative 2, designation of all eligible segments as components of the National Wild and Scenic Rivers System; Alternative 3, designation of Segments A and B; Alternative 4, designation of all eligible segments, with Segment C classified wild instead of recreational; Alternative 5, designation of Segment A. The selected alternative, Alternative 1, is not to recommend any portion of the river for inclusion. This alternative will leave open all future options for management of this area. Major issues and concerns identified for the river area include: the possibility that wild and scenic river designation will foreclose opportunities for future development, such as diversions, mining, and dam construction; concern that the scenic easements acquired on private lands will unduly restrict their use; and the effect that designation could have on upstream communities and water users in regard to maintaining water quality standards. (Moore-SRC)
W82-04076

EFFECTS OF WATER DRAWDOWN ON THE FAUNA IN SMALL COLD WATER RESERVOIRS,
Colorado Div. of Wildlife, Fort Collins.
M. E. McAfee.
Water Resources Bulletin, Vol 16, No 4, p 690-696, August, 1980. 2 Fig, 3 Tab, 49 Ref. OWRT-B-132-COLO.

Descriptors: *Drawdown, *Aquatic animals, *Ecological effects, *Reservoirs, Lakes, Invertebrates, Fish, *Colorado, Mountain lakes, Water temperature, Nutrients, Lake morphometry, Climatic zones.

The effects of complete drawdown in small cold water Colorado reservoirs on fish and invertebrate populations were studied by comparing two lakes drained in the late summers of 1975 and 1976 with 2 nearby lakes having stable water levels. There was no conclusive evidence that complete drawdown affected the fauna. Possibly some factors may have interacted to obscure the drawndown effects. These include edaphic factors, vegetation, lake morphometry, climatic factors, and refuge for fauna. Conditions favoring fish growth which can obscure or lessen drawdown effects are water from a fertile watershed, vegetation contributing debris and nutrients to the water, a larger littoral zone, a shallow mean depth, complete water circulation, a higher water temperature within the species tolerance limit, absence of high winds, and adequate refuge for fauna during low water. The drawdown procedure will be least harmful if the drawdown period is short and in a cool season of the year, if the reservoir partially refills before freezing weather, and if drawdown or refilling does not occur during fish spawning periods. (Cassar-FRC)
W82-04219

ENVIRONMENTAL IMPACT OF CHANNEL MODIFICATION,
Science and Education Administration, Chickasha, OK.
For primary bibliographic entry see Field 4A.
W82-04245

7. RESOURCES DATA

7A. Network Design

GAGE DENSITY AND LOCATION FPR ESTIMATING MEAN ANNUAL PRECIPITATION IN MOUNTAINOUS AREAS,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2B.
W82-03901

ESTIMATING IRRIGATION WATER USE THROUGH SELECTIVE MONITORING: A NORTH FLORIDA CASE STUDY,
Geological Survey, Reston, VA.
T. Wyant, and J. Shoemyen.
Water Resources Bulletin, Vol 16, No 6, p 1074-1079, December, 1980. 5 Fig, 3 Tab, 8 Ref.

Descriptors: *Irrigation water, *Water use, *Sampling, Monitoring, Data acquisition, *Suwannee River Water Management District, *Florida.

186 irrigation system on 84 randomly selected farms in Florida's Suwannee River Water Management District were monitored with accurate electrochemical timers in 1979. Comparisons of the monitoring data with previous records of water use and inventories of irrigation equipment of 603 irrigators in the district (1977) showed that the smaller sample produced 6-9% sampling error. Further error can be introduced if farmers' participation in the monitoring program is related to their water use methods. For example, large volume water users may refuse to participate, leading to underestimates of water use. Random sampling, inclusion of the largest water users, and good public relations are important to the success of a selective sampling program. (Cassar-FRC)
W82-03919

THE WATER BALANCE IN NEWFOUNDLAND,
Memorial Univ. of Newfoundland, St. John's. Dept. of Geography.
W. H. Yoxall.
Water Resources Bulletin, Vol 16, No 6, p 1030-1033, December, 1980. 4 Fig, 2 Tab, 17 Ref.

Descriptors: *Evapotranspiration, *Hydrologic budget, *Newfoundland, Runoff, Networks, Gaging stations, Precipitation, Rainfall-runoff relationships, Water balance.

Newfoundland's water balance cannot be accurately estimated with existing data. Although stream gage data provide reasonably adequate indices of runoff, precipitation values probably have been underestimated. Published values of evapotranspiration vary from 279 to 568 mm, according to the technique used. A good estimate of the province's water balance cannot be obtained without a denser network of precipitation gaging stations and evapotranspiration pan data specific for the region. (Cassar-FRC)
W82-03921

REVISED TECHNIQUES FOR ESTIMATING MAGNITUDE AND FREQUENCY OF FLOODS IN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-03987

RAINFALL-RUNOFF HYDROGRAPH AND BASIN CHARACTERISTICS DATA FOR SMALL STREAMS IN OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-03999

DATA REQUIREMENTS FOR KRIGING: ESTIMATION AND NETWORK DESIGN,
Washington Univ., Seattle. Dept. of Civil Engineering.
J. P. Hughes, and D. P. Lettenmaier.
Water Resources Research, Vol 17, No 6, p 1641-1650, December, 1981. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Kriging, *Network design, *Estimating, Statistical analysis, Sampling, *Hydrologic data, Least squares method, Data interpretation, Data collections.

Kriging, the theory of regionalized variables, is a technique for estimating spatial variation of natural processes from a limited observation networks, for example, the spatial characterization of rainfall, parameters describing groundwater flow, and the variation of water quality in a lake. Comparisons with the conventional least squares method show that for sample sizes less than 50, kriging has no advantages over least squares in a Bayesian sense but may be preferable from the minimax viewpoint. Kriging shows potential use in network design. With a correct model more information is produced, but with a poorly estimated model variance is increased. (Cassar-FRC)
W82-04200

7B. Data Acquisition

CURRENT USE AND TECHNOLOGY OF LANDSAT MSS DATA FOR LAKE TROPHIC CLASSIFICATION,
North Carolina State Univ. at Raleigh.
A. S. Witzig, and C. A. Whitehurst.
Water Resources Bulletin, Vol 17, No 6, p 962-970, December, 1981. 68 Ref.

Descriptors: *Lake classification, *Trophic level, *Remote sensing, Water quality, Satellite technology, *Landsat, Spectral analysis, Sampling.

The current state and use of multispectral data to determine lake trophic classification is described. At present there is no uniform, tested approach to using satellite imagery in this field. Although several states have used this technique to classify lakes to satisfy Federal Water Pollution Control Act requirements, there are large variations in methods of processing the imagery and definition of the trophic indexes. Several trophic indexes in use are reviewed: Carlson's trophic state index based on Secchi disc transparency, Brezonik and Shannon's seven-variable index, Scarpace and Fisher's nine-parameter regression, and others. Methods of relating multispectral data with trophic level include cluster analysis, regression models, three-dimensional color ratio models, automatic data processing, thematic classification map using the Bayesian maximum likelihood algorithm, Wisconsin lake trophic classification, Vermont Landsat classification for Lake Champlain, and Oklahoma reservoir water quality evaluation. Standard sampling, laboratory, and data analysis techniques must be determined for efficiency in correlating ground truth (lake sampling data) with satellite imagery data. Needed are better sensors, a statistically valid sampling program, and analyses of variables usable with Landsat data (Secchi disc transparency, total organic nitrogen, total phosphorus, chlorophyll a, total suspended solids, dissolved suspended material, and nutrients). (Cassar-FRC)
W82-03755

METHANE IN GROUNDWATER AND ITS EFFECT ON 14 C GROUNDWATER DATING,
Niedersachsisches Landesamt fur Bodenforschung, Hannover (Germany, F.R.).
M. A. Geyh, and R. Kunzl.
Journal of Hydrology, Vol 52, No 3/4, p 355-358, July, 1981. 2 Fig, 7 Ref.

Descriptors: *Groundwater dating, *Methane, *Carbon radioisotopes, Performance evaluation, Chemical reactions, West Germany.

Studies of the effects of secondary hydrochemical reactions on the carbon-14 content of groundwater have raised questions regarding the reliability of carbon-14 dating of groundwater. When fossil organic matter in the form of liquid hydrocarbons has been decomposed to methane and carbon dioxide, carbon-14 ages are increased. The methane content of 123 representative samples of groundwater collected in the Federal Republic of Germany which had carbon-14 dated ages exceeding 20,000 years B. P. was determined. About 80 percent of the analyzed groundwater samples contained less than 0.5 micromoles per liter of methane, but only 5 percent had concentrations between 5 and 178 micromoles per liter. Even this 5 percent figure may be high, due to the preferred selection of older samples. Degassed methane-bearing groundwater also seems to be an exception. Various techniques can be used to avoid methane loss from groundwater when sampling. (Carroll-FRC)
W82-03801

WATERSHED MODEL STUDY USING LANDSAT IMAGE DATA,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-03814

HYDROLOGICAL STUDIES POSSIBLE WITH RADIONUCLIDES OF BOMB-TEST, PRIMORDIAL AND NATURAL ORIGIN TO COMPLEMENT INVESTIGATIONS USING MANUFACTURED RADIOTRACERS,
For primary bibliographic entry see Field 5B.
W82-03836

RATES OF RECENT SEDIMENTATION IN LAKE PEPIN,
Science and Education Administration, Oxford, MS.
For primary bibliographic entry see Field 2J.
W82-03922

WATER RESOURCES INVESTIGATIONS IN WEST CENTRAL IRAN USING LANDSAT DATA,
Southern Illinois Univ., Carbondale. Dept. of Forestry.
M. S. Akhavi.
Water Resources Bulletin, Vol 16, No 6, p 987-995, December, 1980. 5 Fig, 3 Tab, 22 Ref.

Descriptors: *Saline lakes, *Water resources development, *Satellite technology, Lakes, *Remote sensing, Landsat, Daryacheh-ye-Namak, *Iran, Water quality control, Dams, Arid lands, Playas, Rivers, Water storage, Water depth.

Landsat data were used to monitor the water area and compute the water volume of Daryacheh-ye-Namak, a salt lake in a 78,500 sq km watershed which encompasses heavily populated and industrial sections of Iran, including Tehran. Combining satellite observations with measurements of stream discharges into the lake showed that groundwater is being discharged into the lake. Since fresh water entering the lake becomes saline and therefore unusable, it is suggested that the fresh water be diverted or stored for use in this arid region. The maximum volume of the lake during this study was 300 million cu m in May 1976. The Saveh and Ghom Rivers could provide 400 and 150 million cu m per year of fresh water if storage dams are constructed. There is also a possibility of recovering the salt resources. (Cassar-FRC)
W82-03927

INVENTORY OF SURFACE WATER RESOURCES OF THE STILLWATER CREEK WATERSHED AND AN INVESTIGATION INTO THE EFFECT OF LAND USE ON WATER QUALITY,
Oklahoma State Univ., Stillwater. Center for Applications of Remote Sensing.
L. Bunse, E. Constrance, T. Kelly, S. J. Walsh, and W. A. Blanchard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-197930, Price codes: A05 in paper copy, A01 in microfiche. --Oklahoma Water Resources Research Institute, Oklahoma State University Technical Completion Report, September 1981. 80 p 21 Fig, 3 Tab, 21 Ref, 3 Append. OWRT-A-102-OKLA(1), 14-34-0001-1138.

Descriptors: Land use, *Water quality, *Remote sensing, LANDSAT, Inventory, *Surface water, Watershed management, *Stillwater Creek watershed, *Oklahoma.

Lakes, ponds and reservoirs greater than 2.5 ha (5 acres) in size and major rivers and creeks of the Stillwater Creek watershed were inventoried through the application of Landsat digital data processed and analyzed at the Oklahoma State University Center for Applications of Remote Sensing. The identified water bodies were analyzed as to their water quality based on their trophic state and sedimentation level. Land use activities and water quality, in addition to riparian vegetation and non-point sources of pollution were analyzed for 1975 and 1981 to determine: (1) how changes in land use conditions have affected water quality; (2) how fluctuations in land use have affected non-point sources of water pollution; (3) how changes in land use activities and water quality have affected riparian vegetation; and (4) how the water body has evolved since 1975 in terms of trophic level and sedimentation load.
W82-03948

USE OF LONGITUDINAL CONDUCTANCE IN ESTIMATING TRANSMISSIVITY OF GRANULAR AQUIFERS IN NORTHERN MISSOURI,
Missouri Univ.-Columbia. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-03957

USE OF PRE-FABRICATED PARSHALL FLUMES TO MEASURE STREAMFLOW IN PERMAFROST-DOMINATED WATERSHEDS,
Pacific Northwest Forest and Range Experiment Station, Fairbanks, AK. Inst. of Northern Forestry.
C. W. Slaughter.
Forest Service Research Note PNW-382, April, 1981. 8 p, 3 Fig, 12 Ref.

Descriptors: *Flumes, *Permafrost, *Flow measurement, *Streamflow, Environemtnal effects, Bank erosion, Thawing, Thermal pollution, Runoff, Monitoring, *Alaska.

The occurrence of permafrost in stream valleys of central Alaska causes problems with conventional stream-gauging installations. Construction of cut-off walls in a stream bank composed of ice-rich silt can result in heat input to the bank, from decreased surface albedo and insulation resulting from construction, and from the higher thermal conductivity of material used in the cutoff walls. Ponds formed upstream from an artificial control can constitute major sources of heat transfer. Because of the problems of thermal and physical bank degradation in installations utilizing weirs and pools, prefabricated fiberglass Parshall flumes for streamflow measurement were installed in first-order streams in permafrost-dominated central Alaska. Flumes ranged in capacity from 263 to 700 l/S and have performed satisfactorily for two open-water runoff seasons. The flume installations have provided a relatively inexpensive, accurate, and low-site-impact method of continuous runoff monitoring. Critical to this success was the care taken to minimize physical and thermal disturbance to both banks and channels at installation sites. (Moore-SRC)
W82-04074

OPERATIONAL APPLICATIONS OF SATELLITE SNOW COVER OBSERVATIONS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
A. Rango.
Water Resources Bulletin, Vol 16, No 6, p 1066-1073, December, 1980. 6 Fig, 18 Ref.

Descriptors: *Snow cover, *Satellite technology, *Runoff forecasting, Remote sensing, *Streamflow forecasting, Forecasting, Benefits, Cost-benefit analysis, Snowmelt.

An Applications Systems Verification and Transfer Project on the operational applications of satellite snow cover observations was completed. Three years of testing in California and model studies in the Boise River basin, Idaho, showed that satellite snow cover data could reduce errors in streamflow forecasts by 5% over a three-year period in the California watersheds and by -2.0 to 9.6% for 3-14 day forecasts in the Idaho study. The benefit/cost ratio for this program was 75;1 for 11 western states. Benefits were $10 million for hydropower and $28 million for irrigation; costs were $505,000. The goal for data delivery was 72 hours because snowmelt runoff forecasting is a dynamic situation. Landsat data, effectively analyzed by the zoom transfer scope techniques, generally required about 7 days for delivery. National Environmental Satellite Service was better suited to the 72 hour goal. (Cassar-FRC)
W82-04150

AIRCRAFT RADAR RESPONSES TO SOIL MOISTURE,
Kansas Univ., Center for Research Inc., Lawrence. Remote Sensing Lab.
G. A. Bradley, and F. T. Ulaby.
Remote Sensing of Environment, Vol 11, No 6, p 419-438, 1981. 18 Fig, 5 Tab, 12 Ref.

Descriptors: *Remote sensing, *Radar, *Soil water, Agriculture, Colby, Kansas, Aircraft, Vegetation effects, Cultivation.

Aircraft like-polarization HH radar response to soil moisture in the upper surface layer of agricultural fields was comparable to the response measured in truck radar studies on bare and vegetation-covered fields with no row tillage patterns or for fields with rows parallel to the radar look direction. There were 35 fields, bare of containing wheat stubble, corn, milo, pasture, or alfalfa. Aircraft radar measurements were taken near Colby, Kansas, in 1978 at 1.6 GHz and 4.75 GHz using like-polazation (HH) and cross-polarzation (HV) and at 13.3 GHz using VV polarization. Optimum response was at C-band frequencies and incidence angles of 10-20 degrees. Like-polarization radar response was dependent on row tillage patterns; cross-polarization response was nearly insensitive to tillage patterns. Both responses were unaffected by the presence of type of vegetation cover. Results show that radar can be used to detect and estimate near-surface soil moisture in agricultural fields. (Cassar-FRC)
W82-04187

A SIMPLE METHOD FOR ESTIMATING CONVECTIVE RAIN VOLUME OVER AN AREA,
South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
A. A. Doneaud, P. L. Smith, A. S. Dennis, and S. Sengupta.
Water Resources Research, Vol 17, No 6, p 1676-1682, December, 1981. 4 Fig, 2 Tab, 23 Ref.

Descriptors: *Convective precipitation, *Radar, *Remote sensing, Precipitation, Rain gages, Gages, Rainstorms, *Rainfall, *North Dakota.

A simple method for estimating convective rainfall by considering only the horizontal extent and duration of the precipitation is presented. It is based on observed correlations between the horizontal extent of convective storms and the volume of rain they produce. Rain gage and radar data from a cloud seeding experiment in North Dakota were used to develop the method. The integrated rainfall coverage may be calculated either from radar data (summing the maximum echo area coverage during any radar scan in each hour) or, less satisfactory, from hourly rain gage reports. Then the rain volume is estimated from the integrated rainfall coverage using a graph, which must be prepared from radar and rain gage data for the region in question. (Cassar-FRC)
W82-04201

7C. Evaluation, Processing and Publication

URGENT PROBLEMS IN THE TRANSFER OF WATER RESOURCES KNOWLEDGE,
North Carolina Water Resources Research Inst.
N. S. Grigg.
Journal of Hydrology, Vol 51, No 1-4, p 277-281, May, 1981. 1 Ref.

Descriptors: *Information exchange, *Water resources development, Water management, Management planning, Data storage and retrieval, Information systems, *Technology transfer.

This report summarizes the results of the Second International Conference on Transfer of Water Resources Knowledge, which was held at Colorado State University in June 1977. The Conference focused specifically on the problem of transferring water resources knowledge, including technology, information, and data, to meet such objectives as helping communities develop adequate water supplies and effective wastewater management systems, helping to assure adequate water supplies for

both instream uses and a wide range of consumptive uses, and helping to reduce losses from flooding. The Conference specifically addressed questions relating to how water resources research can be managed to ensure the transfer of useful results to users, how water resources scientific information systems can be developed and improved to enhance knowledge transfer, and how water resources knowledge can be applied to improve living conditions in poor rural areas. The results of the Conference stressed the need for improved relations between researchers and scientific institutions and water resources managers and agencies. Decision-makers need to have access to clear, credible, and pertinent information, rather than to the current deluge of raw information, reports, and data. Information systems need to be more compatible, flexible, and responsive to user needs. The financing and organizing of research projects should be reordered to bring researchers and users into closer working relationships. Finally, international development activities should be responsive to the need of rural and underdeveloped areas for access to low-risk, high-reliability technology. (Carroll-FRC)
W82-03802

HYDROLOGIC APPLICATIONS OF WEATHER AND CLIMATE INFORMATION,
Illinois State Water Survey Div., Champaign.
S. A. Changnon.
Journal of the American Water Works Association, Vol 73, No 10, p 514-518, October, 1981. 2 Fig, 20 Ref.

Descriptors: *Hydrologic data collections, *Water management, Data collections, Chicago, Metropolitan water management, Weather forecasting.

This paper describes innovative uses of weather and climate information that can help hydrologists solve water problems. New findings relevant to water issues concern climatic changes, long-range climate predictions, and rainfall prediction systems. Recent applications of climatic findings and refined forecasting capabilities developed in the Chicago area are discussed to illustrate innovative solutions to institutional water issues. These applications have been used to make improvements in the design and operation of water management systems in the Chicago metropolitan area. Recent approaches to long range predictions are also discussed. Forecasts of heavy rain proved accurate enough to use in the management of complex urban drainage systems. Radar-meteorologic systems showed good potential for helping to manage and operate urban sewer systems. The credence given to climatic fluctuations and man-induced rainfall changes in adjusting water diversion management, as reflected by the 1980 settlement of the Lake Michigan diversion issue, is an indication of acceptance and use of new climatic findings in institutional decisions about water issues. The use of historic statistics to evolve probability predictions of heavy rain occurrences, the emerging capabilities to predict trends in annual rainfall, and the use of normals as one year predictors of annual precipitation are uses growing out of the evolving capabilities in climatology. (Baker-FRC)
W82-03871

INFORMATION MANAGEMENT: A ROLE FOR PRIMACY AGENCIES IN THE 80S,
Utah Dept. of Health, Salt Lake City. Bureau of Public Water Supplies.
For primary bibliographic entry see Field 10B.
W82-03891

TOPOGRAPHIC MAP OF GOLDEN GATE ESTATES, COLLIER COUNTY, FLORIDA,
Geological Survey, Miami, FL. Water Resources Div.
A. Jurado.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $7.00, Microfiche $1.00. Geological Survey Open-File Report 81-1073, 1981. 2 Plates.

Descriptors: *Maps, *Canal construction, *Land development, *Small watersheds, Elevation, Topography, Groundwater, Surface water, Contours, *Drainage patterns, Water level, *Florida, Collier County.

Construction of canals related to land development in the Golden Gate Estates area of Collier County, Fla., has altered the natural drainage pattern of the watershed. The area of approximately 300 square miles was topographically mapped with a contour interval of 0.5 foot to assist in determining the effects of canal construction on the surface-water and ground-water resources in the watershed. The topographic map was prepared at a scale of 1:48,000 using aerial photography and ground-control points. (USGS)
W82-03973

HYDROLOGIC ALMANAC OF FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. C. Heath, and C. S. Conover.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $32.50, Microfiche $3.50. Geological Survey Open-File Report 81-1107, 1981. 239 p, 83 Fig, 55 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Publications, Water management, Hurricanes, Earthquakes, Lakes, Streams, Springs, Water use, Water supply, Water analysis, Bibliographies, *Florida.

This first edition is a ready reference source of information on various facts and features about water in Florida. It is aimed primarily to help bust politicians, writers, agency officials, water managers, planners, consultants, educators, hydrologists, engineers, scientists, and the general public answer questions that arise on comparative and statistical aspects on the hydrology of Florida. It contains statistical comparative data, much of which was especially prepared for the almanac, a glossary of technical terms, tabular material, and conversion factors. Also included is a selective bibliography of 174 reports on water in Florida. (USGS)
W82-03974

DELINEATION OF FLOOD HAZARDS IN THE JAYNES QUADRANGLE, PIMA COUNTY, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
R. M. Myrick, and B. N. Aldridge.
Available from Br. of Dist. USGS, Box 25286, Fed. Ctr. Denver, CO 80225. Price $2.50. Geological Survey Miscellaneous Investigations Series Map I-843-D, 1981. 1 Sheet, 5 Fig, 6 Ref.

Descriptors: *Maps, *Floods, *Hazards, *Flood damage, *Flow characteristics, Flood plains, Streams, Alluvial fans, Flash floods, Flood data, Flood frequency, Flood peak, Obstructions to flow, Erosion, Bank erosion, Laminar flow, Urbanization, *Arizona, Pima County, *Jaynes quadrangle.

All land in the Jaynes quadrangle is classified on the basis of potential flood hazard. The potential flood hazard is greatest on the flood plains of the Santa Cruz River, Rillito Creek, and Canada del Oro--the major streams in the Jaynes quadrangle. The potential flood hazard is minimal on the rolling foothills and steep rocky hillsides of the uplands, although in the uplands significant potential flood hazards exist in the narrow flood plains of several small tributaries and on the alluvial fans. Areas of significant special hazards are identified. (USGS)
W82-03976

MAP SHOWING GENERAL CHEMICAL QUALITY OF GROUND WATER IN THE RICHFIELD QUADRANGLE, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
D. Price.
Available from Br. of Dist. USGS, Box 25286, Fed. Ctr. Denver, CO 80225. Price $2.50. Geological Survey Miscellaneous Investigations Series Map-I 1374, 1981. 1 Sheet, 23 Ref.

Descriptors: *Water quality, *Maps, *Groundwater, *Wells, *Thermal springs, Aquifers, Geology, Chemical composition, Dissolved solids, *Utah, *Richfield quadrangle, Great Basin.

This is one of a series of maps that describe the geology and related natural resources of the Richfield Quadrangle, Utah. It shows known and inferred ranges of dissolved-solids concentrations in the ground water. Concentrations generaly range from 100 to 1,000 milligrams per liter throughout most of the map area. They are less than 100 milligrams per liter locally in some higher mountain areas and more than 10,000 milligrams per liter locally beneath the Sevier Desert and Sevier Lake bed. Several mineralized thermal springs discharge in the map area. They include Thermo, Roosevelt, Joseph, Red Hill, Monroe, Meadow, and Hatton Hot Springs. Dissolved-solids concentrations of those springs range from about 1,500 to about 8,000 milligrams per liter. (USGS)
W82-03977

GEOLOGIC STRUCTURE, HYDROLOGY, AND WATER QUALITY OF THE LARAMIEFOX HILLS AQUIFER IN THE DENVER BASIN, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div., and Colorado Dept. of Natural Resources, Denver.
S. G. Robson, A. Wacinski, S. Zawistowski, and J. C. Romero.
Available from Br. of Dist. USGS, Box 25286, Fed. Ctr., Denver, CO 80225, Price: 7.50. Geological Survey Hydrologic Investigations Atlas HA-650, 1981. 3 Sheets, 13 Fig, 1 Tab, 11 Ref.

Descriptors: *Geohydrology, *Water quality, *Aquifers, *Water supply, Groundwater, Water demand, Aquifer characteristics, Groundwater movement, Stream discharge, Groundwater recharge, Water level, *Colorado, Denver basin, *Laramie-Fox Hills aquifer.

The Laramie-Fox Hills aquifer underlies an area of about 6,700 square miles in east-central Colorado and is an important water supply for many residents in the area. Population increases have produced increasing demands for ground water and have led to significant water-level declines in parts of the aquifer. Results of this study, which was undertaken to better define the water-supply potential of the aquifer, indicate that the aquifer consists of interbedded sandstone, siltstone and shale at depths of as much as 3,200 feet. The water-yielding sandstone and siltstone beds have a total thickness of more than 200 feet in some areas. The 1978 potentiometric-surface map indicates that ground water moves from the south-central part of the aquifer toward the margins of the aquifer where most of the water discharges to streams and alluvial aquifers. Some groundwater recharge occurs as downward movement of water from the overlying Arapahoe aquifer. Water-level declines between 1958 and 1978 exceeded 200 feet in an 80-square-mile area near Brighton, while in other parts of the aquifer only moderate changes have occurred. Water in the aquifer is generally of a sodium bicarbonate type with dissolved-solids concentrations commonly ranging from 400 to 1,200 milligrams per liter. (USGS)
W82-03978

MAP SHOWING THE POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER IN SOUTHERN MARYLAND, AUGUST 1980,
Geological Survey, Annapolis, MD. Water Resources Div.
F. K. Mack, J. C. Wheeler, and S. E. Curtin.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Paper copy $1.00, Microfiche $3.50. Geological Survey Open-File Report 81-633 (WRI), 1981. 1 Sheet.

Descriptors: *Maps, *Potentiometric level, *Aquifers, *Observation wells, Groundwater level, Coastal plains, *Maryland, *Magothy aquifer.

This map is based on measurements made in a network of 77 observation wells. Highest levels of the potentiometric surface, 61 to 64 feet above sea

level, were near the outcrop or subcrop of the aquifer in topographically high areas of Anne Arundel and northern Prince Georges Counties. The potentiometric surface slopes toward centers of pumpage near Annapolis, in northern Charles County, and southern Prince Georges County. Two separate, distinct, and extensive cones of depression have developed in the surface around the well fields of Waldorf, in northern Charles County, and the Chalk Point power plant, in southern Prince Georges County. The cone of depression in the Annapolis area has coalesced with a more shallow cone that includes the Broadneck Peninsula. The network of wells was developed and is operated and maintained as part of the cooperative program between the U.S. Geological Survey and agencies of the Maryland Department of Natural Resources. (USGS)
W82-03981

MAP SHOWING HOW THE POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER OF SEPTEMBER 1979 DIFFERED FROM THE POTENTIOMETRIC SURFACE OF SEPTEMBER 1977, IN SOUTHERN MARYLAND,
Geological Survey, Annapolis, MD. Water Resources Div.
F. K. Mack, J. C. Wheeler, and S. E. Curtin.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $1.00, Microfiche $3.50. Geological Survey Open-File Report 81-632 (WRI), 1981. 1 Sheet.

Descriptors: *Maps, *Potentiometric level, *Aquifers, *Observation wells, Groundwater level, Coastal plains, *Maryland, *Magothy aquifer.

This map is based on the differences between two sets of water-level measurements made in 63 observation wells. One set was made in 1977, a relatively dry year, and the other set was made in 1979, a relatively wet year. The map shows that the potentiometric surface in 1979, in northern Prince Georges County and southern Anne Arundel County, was higher than it was in 1977, with a maximum measured rise of 9 feet. In southern parts of the mapped area, the 1979 potentiometric surface was lower than the 1977 surface, with a maximum measured decline of 11 feet. The network of observation wells was developed and is operated and maintained as part of the cooperative program between the U.S. Geological Survey and agencies of the Maryland Department of Natural Resources. (USGS)
W82-03983

WATER RESOURCES INVESTIGATIONS IN MISSISSIPPI 1980-81.
Geological Survey, Jackson, MS. Water Resources Div.
Geological Survey Mississippi District Report, March 1981. 74 p, 22 Ref. (compiled by Gandl, L.A.).

Descriptors: *Data collections, *Surface water, *Groundwater, *Water quality, Floods, Water use, Available water, Streamflow, Flow characteristics, *Mississippi, Water resources projects, Progress report.

This report describes the activities of the Water Resources Division in Mississippi. It summarizes progress made in water-resources investigations and related activities during the fiscal year ending September 30, 1980. This is accomplished through cooperation with other Federal and non-Federal agencies, by: (1) collecting, on a systematic basis, data needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources; (2) conducting analytical and interpretive water-resource appraisals describing the occurrence, availability, and physical, chemical, and biological characteristics of surface and ground water; (3) conducting supportive basic and problem-oriented research in hydraulics, hydrology, and related fields of science to improve the scientific basis for investigations and measurement techniques and to understand hydrologic systems sufficiently well to quantitatively predict their response to stress, either natural or manmade; (4) disseminating the water data and the results of these investigations and research through reports, maps, computerized information services, and other forms of public releases; (5) coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, estuaries, and ground waters; and (6) providing scientific and technical assistance in hydrologic fields to other Federal, State, and local agencies. (USGS)
W82-03988

WATER RESOURCES DATA FOR WEST VIRGINIA, WATER YEAR 1979. APPENDIX - COAL AREAS.
Geological Survey, Charleston, WV. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-154329, Price codes: A13 in paper copy, A01 in microfiche. Geological Survey Water-Data Report WV-79-A, November, 1980. 287 p, 15 Fig, 8 Tab.

Descriptors: *Coal, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Coal mines, Wells, Water level, Data collections, Sites, *West Virginia, Coal areas.

Water resources data for the 1979 water year for coal regions of West Virginia consist of records of discharge and water quality of streams, wells, mines, and abandoned mine shafts; and water levels in wells and abandoned mine shafts. Section one consists of data obtained for the statewide Coal Hydrology Monitoring Project and includes discharge and water-quality data collected during two sampling periods at 361 sites. Section two consists of data obtained for the Mining Effects Research Project in five small basins in southwestern West Virginia during the period February 1976 to January 1980 and includes records of water quality for 53 stream sampling sites, 52 well sampling sites, 31 mine-discharge sampling sites, and 2 mine-shaft sampling sites; and water levels in 6 wells and 2 mine shafts. (USGS)
W82-03990

GROUND-WATER LEVELS IN SELECTED WELL FIELDS AND IN WEST-CENTRAL FLORIDA, MAY 1981,
Geological Survey, Tampa, FL. Water Resources Div.
D. K. Yobbi, and W. M. Woodham.
Available from OFSS, USGS 25425, Fed. Ctr. Denver, CO 80225. Paper copy $5.25, Microfiche $1.00. Geological Survey Open-File Report 81-1106, 1981. 2 Sheets, 2 Tab, 2 Ref.

Descriptors: *Potentiometric level, *Groundwater, *Maps, Subsurface water, Aquifers, Water table, Wells, Water level fluctuations, *West-central Florida, *Floridan aquifer.

The water table in the surficial aquifer and the potentiometric surface of the Floridan aquifer in a 1,200-square-mile area in west-central Florida are mapped semi-annually by the U.S. Geological Survey. Maps are based on water levels measured in wells each May to coincide with seasonal low levels and each September to coincide with seasonal high levels. The mapped area shows 14 well fields that supplied 200.7 million gallons to municipalities on May 18, 1981. The water is withdrawn from the Floridan aquifer, the major aquifer in Florida. The effect of localized withdrawal on ground water is shown on the maps as depressions in both the potentiometric and water-table surfaces. Water levels were lower in May 1981 than in May and September 1980. Annual change of water levels ranged from decreases of 19 feet at Sun City well field to less than 1 foot at Eldridge-Wilde well field. (USGS)
W82-03992

WATER-QUALITY RECONNAISSANCE OF HARDING CREEK, LAWRENCE COUNTY, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
J. C. Petersen.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $2.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-1058, 1981. 16 p, 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Water quality, *Surface water, Data collections, Sampling, Streamflow, Nutrients, Metals, Dissolved solids, Bacteria, Sediment discharge, *Arkansas, Lawrence County, *Harding Creek.

A study of Harding Creek conducted between April and October 1980 to assess the water quality of the creek indicates no serious water-quality problems. Eight water samples were collected during periods of low to moderate streamflow (less than 19 cubic feet per second). The water was hard to very hard (100 to 220 milligrams per liter as calcium carbonate) and dissolved-solids concentrations ranged from 112 to 244 milligrams per liter. Suspended-sediment concentrations were low (generally less than 5 milligrams per liter). Total phosphorus concentrations did not exceed 50 micrograms per liter, and total nitrogen concentrations were less than 1.9 milligrams per liter. Concentrations of most metals were less than 5 micrograms per liter, the exceptions being iron (110 to 210 micrograms per liter), manganese (20 to 80 micrograms per liter), and zinc (0 to 30 micrograms per liter). Fecal-coliform bacteria were present in some samples in large enough numbers (as many as 710 colonies per 100 milliliters) to indicate that the U.S. Environmental Protection Agency criterion and Arkansas water-quality standards may be exceeded at times. (USGS)
W82-03995

WATER USE DATA--WHO NEEDS IT,
Geological Survey, Reston, VA.
J. E. Schefter, and D. W. Moody.
Water Resources Bulletin, Vol 17, No 6, p 978-986, December, 1981. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Information systems, *Data collections, *Water use, Decision making, Water demand, Water management, Water allocation, Low control, Energy, Simulation analysis, Model studies, Econometrics, *Data storage and retrieval.

Water use information is produced by combining water use data and ancillary data within a theoretical framework to address a problem. This information is useful in water management problems and issues (water utility systems design, water allocation alternatives, water quality control by flow control and augmentation, and the impact of energy production on water availability) and economic modeling (plant process simulation models, input/output and mathematical programming models, and econometric models). Examination of the costs and benefits of the use of water use information in problems of this type indicates that there is a potential value to water use data. Problems in existing data bass are described. An adequate water use data base for general use would: (1) be periodic, nationwide and provide a sample of water use by all major categories of users, (2) distinguish between consumption and withdrawal, identify sources of water, quality of intake, point of discharge, and quality of effluents for each user and by type of use, (3) contain actual measurements from a sample of users and aggregate estimates of total use based on the sample along with standard errors of the estimates, and (4) contain ancillary data to permit users to combine water use data with economic, demographic, etc., data. The problems of placing a value on water use data include the fugitive nature of data (measurements not made are permanently lost) and a lack of understanding of the information production function and the roles of water use information in decision making. (Cassar-FRC)
W82-04198

GEOHYDROLOGIC APPRAISAL OF WATER RESOURCES OF THE SOUTH FORK, LONG ISLAND, NEW YORK,

Geological Survey, Syosset, NY. Water Resources Div.
B. Nemickas, and E. J. Koszalka.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $7.50. Geological Survey Water-Supply Paper 2073, 1982. 55 p, 30 Fig, 9 Plates, 11 Tab, 33 Ref.

Descriptors: *Geohydrology, *Groundwater, *Aquifers, *Aquifer characteristics, Available water, Hydraulic properties, Groundwater movement, Recharge, Saline-freshwater interfaces, Water supply,, Surface water, Water quality, Maps, New York, *Long Island, South Fork, *Natural recharge Rainfall.

The South Fork of Long Island consists of a Paleozoic basement complex overlain by Cretaceous and Pleistocene sediments. The surficial material consists of late Wisconsinan glacial and glaciofluvial deposits in association with beach and marsh deposits. The sole source of fresh ground water is precipitation. Average annual precipitation in the region is 45 inches, of which about half reaches the ground-water reservoir. Overland runoff is estimated to be 0.5 inches per year; evapotranspiration is calculated to be 23 inches per year. Average horizontal hydraulic conductivity of the Magothy aquifer (Cretaceous) is 70 feet per day; that of the upper glacial aquifer (Pleistocene) is 350 feet per day. Transmissivity of the Magothy aquifer ranges from 600 to 24,100 feet squared per day; transmissivity of the upper glacial aquifer ranges from 5,400 to 22,700 feet squared per day. The position of the freshwater/saline-water interface is depicted in maps. The freshwater reservoir follows the Ghyben-Herzberg principle in the southern part of the study area, but in the northern part, the calculated depth to interface is less than expected. Thus difference is attributed to greater anisotrophy in the northern part. (USGS)
W82-04206

8. ENGINEERING WORKS

8A. Structures

RESERVOIRS AND THE TRIGGERING OF EARTHQUAKES,
Open Univ., Milton Keynes (England). Dept. of Earth Sciences.
P. J. Smith.
Nature (London), Vol 295, No 5844, p 9, January 7, 1982.

Descriptors: *Reservoirs, *Environmental effects, Construction, *Seismology, Seismic waves, Earth pressure, *Earthquakes, Nurek Reservoir, *USSR, Reservoir construction.

Well documented examples of reservoir-induced seismicity are known throughout the inhabited continents. Generally speaking, what happens is that the huge mass of water in a reservoir changes the stress patterns in the underlying rocks. By exerting a vertical pressure while the pore pressure in the rocks gradually increases and by reducing the coefficient of initial friction, the mass of water may produce seismic events in a highly stressed system which is already close to thee breaking point. Such has been generating seismic activity since filling began in the early 1970s. The induced seismicity was not related directly to the absolute amount of water present, but to variations in it. Bursts of seismic activity are triggered when the water level changes, the intensity of the activity increasing with the rate of level change. The pattern of seismicity which results depends very much upon local conditions. For example, the lithological environment in the Nurek area is not unusually inhomogeneous on a regional scale, yet the distribution of seismic activity varies on a subreservoir scale. If the environmental effects of future reservoir impounding are to be predicted accurately, it will be necessary to investigate the rocks underlying the sites in greater detail than has been done in the past. (Baker-FRC)
W82-03766

NUMERICAL SOLUTION OF THE DAM FAILURE PROBLEM BY THE RANDOM CHOICE METHOD,
Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Centro de Computos.
G. Marshall, and A. N. Menendez.
Advances in Water Resources, Vol 4, No 3, p 125-133, September, 1981. 16 Fig, 13 Ref.

Descriptors: *Mathematical equations, *Theoretical analysis, *Dam failure, *Channel flow, Mathematical studies, Flow friction, Slopes, Mathematical models, Graphical methods, Graphical analysis, Mathematical analysis, Shallow water, Random choice method.

The random choice method (RCM) was used to formulate a numerical solution to the dam failure problem as described by the one-dimensional shallow water equations. The RCM utilizes the superposition of locally theoretical solutions and sampling methods. Optimum sampling techniques are obtained by application of the RCM to the scalar wave equation. Solutions to the dam failure problem compared very favorably with theoretical solutions. The RCM represented the constant state exactly, gave the bore with almost infinite resolution, and computed the depression wave very accurately. The RCM may be extended to include friction and slope effects. (Geiger-FRC)
W82-03872

THE VALUE OF EXPLORATORY TEST HOLES IN GROUND WATER DEVELOPMENT,
For primary bibliographic entry see Field 2F.
W82-03896

PROBLEMS OF LIGHTENING UNDERGROUND STRUCTURES AND METHODS OF CONSTRUCTING THEM UNDER PERMAFROST CONDITIONS,
G. A. Gevirts, I. N. Ternovskii, V. M. Mostkov, and V. L. Chelnokov.
Hydrotechnical Construction, No 2, p 131-140, February, 1980. 5 Fig, 3 Tab, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 2, p 14-20, February, 1980.

Descriptors: *Tunnel linings, *Permafrost, *Hydroelectric plants, Linings, Concrete technology, Reinforced concrete, Geologic fractures, Frozen ground, Hydraulic structures, Underground structures, Thawing, Rock bolts.

Construction of underground rooms and tunnels at hydroelectric plants presents special problems under permafrost conditions. The instability caused by gradual thawing of rock-ice masses, especially in fractured rocks and tectonic zones, makes the usual rigid concrete or reinforced concrete tunnel linings ineffective. A reinforced concrete arch with 22 m span was developed in which 3 and 6 m long metal anchors are driven into the frozen rock. These are interconnected along the inside contour of the working by longitudinal and transverse reinforcement. A 15 cm layer of sprayed concrete is applied to the resulting mesh. Expanding cement with a setting time of 15-20 min is used. Addition of potash preserves the liquid phase in the mortar and promotes hardening. The construction is lightweight and requires less time, money, and materials than standard concrete methods. It eliminates the need for shuttering, deep heating of the rock mass to allow concrete hardening, and fill-in grouting. It protects against cave-ins by using the bearing capacity of the rocks themselves. (Cassar-FRC)
W82-03918

A SURFACE WATER OUTFALL SEWER FOR BOURNEMOUTH BY-PASS.
Water Services, Vol 85, No 1027, p 458-460, September, 1981. 3 Fig.

Descriptors: *Outfall sewers, *Construction, Sewers, Outfall, Bournemouth, Bypass channels, Design criteria, *Tunnel construction, Wessex Ways, *England.

A surface water outfall sewer was needed to complete construction of a new Bournesmouth by-pass linking the Wessex Ways. Existing surface water sewers would not be able to cope with the additional flow from the new bypass. A tunnel was to be made to extend to an existing outfall tunnel deep under Bournesmouth, and three alternative routes were investigated. Various problems were encountered during the construction of the by-pass. Some of these problems included perched water tables requiring pumping, extremes of density of surrounding sand causing the shaft to lean towards the softer side, influxes of silt, extreme vibrating conditions causing difficulties in nearby homes, a lack of oxygen necessitating suspension of work until the oxygen levels rose to a permitted level, and extreme corrosiveness of sand necessitating two steel blade spades to be used every working shift. (Baker-FRC)
W82-04003

THE THAMES BARRIER,
For primary bibliographic entry see Field 4A.
W82-04039

A DECISION THEORY APPROACH TO EARTH DAM CLASSIFICATION,
Maryland Univ., College Park, Dept. of Civil Engineering.
R. H. McCuen.
Water Resources Bulletin, Vol 16, No 3, p 546-549, June, 1980. 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Risks, *Dam failure, *Classification, *Earth dams, Decision theory, *Dam stability, Safety, Statistical analysis, Mathematical studies.

A Bayesian approach to earth dam classification directly evaluates the effects of uncertainties. This is a better risk assessment method than classical statistics. A framework for applying the decision theory is presented. It avoids the pessimism inherent in the yes-no minimax method (Savage, 1954) and prevents over-design wth respect to safety. The information produced from an evaluation of this type can also be used for selecting design criteria. (Cassar-FRC)
W82-04152

THE OPTIMUM SIZE OF SMALL RUN-OF-RIVER PLANTS,
Development Corp., St. Vincent (West Indies).
P. R. Gingold.
International Water Power and Dam Construction, Vol 33, No 11, p 50-53, November, 1981. 6 Fig, 3 Tab.

Descriptors: *Hydroelectric plants, *Cost-benefit analysis, *Rivers, Benefits, Optimization, Economic evaluation, Developing countries, Tropical regions, Design criteria, Temperate zone, Comparison studies.

A search for the optimum size of small (about 1 MW) run-of-river hydroelectric plants produced a wide range of acceptable sizes. Several types of flow regime were considered: Type A, a tropical river with a single strong maximum flow and a short low water period; type B, a tropical river with a single strong maximum flow and a long low water period; and type C, a temperature river with all year flow and a warm season minimum. Optimum size and range of sizes for which benefit cost ratios exceed unity are (in kW): Type A, 1100 and 260-3000+; Type B, 1850 and 400-3000+; and Type C, 1300 and 250-3000+. Results indicate that the larger end of the plant size range would be more sensible. In addition, very detailed feasibility studies are not necessary for small installations. (Cassar-FRC)
W82-04175

SMALL AND LOW-HEAD HYDRO IN THE USA,
CH2M/Hill, Bellevue, WA.
R. W. Gillette.
International Water Power and Dam Construction, Vol 33, No 11, p 25-29, November, 1981. 4 Fig.

Descriptors: *Hydroelectric plants, *Dams, *Water resources development, Hydraulic structures, Lake Redding, California, Bull Run River, Oregon, Kingsley Dam, Nebraska, Powerplants, Small hydropower plants, United States.

The growing interest in small hydropower development in the U.S. is illustrated by means of three proposed projects at existing dams. The Lake Reeding, California, project ($55.6 million) would supply 10% of the area's energy. Since a head of 2.4 m is present when the stoplogs are in place for the irrigation season, it will be necessary to raise the forebay and lower the tailwater elevation subject to constraints imposed by an upstream dam, esthetic considerations, and the upstream salmon spawning grounds. Maximum head will be 4.3 m, and generator capacity, 14.5 MW. The 50 MW Kingsley Dam, Nebraska, hydropower project ($52 million in 1985 dollars) will consist of a single-turbine generating station using only a portion of the outlet flow. A diversion dam will be raised by 1.8-3 m and gates to the irrigation supply canal lowered by 0.5 m. Near Portland, Oregon, the Bull run River has two dams fitted with hydraulic structures for hydro development, presently used for municipal water supply. Addition of powerhouses and modifications of intake structures are expected to cost $55 million. Special provisions are included to assure that water quality will not be affected and that water level fluctuations will be carefully controlled. (Cassar-FRC)
W82-04176

8B. Hydraulics

DISCUSSION OF 'TURBULENCE PREDICTION IN OPEN CHANNEL FLOW',
Delhi Coll. of Engineering (India).
R. Devi, and A. Kumar.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY3, p 382-383, March, 1981. 3 Ref.

Descriptors: *Flow characteristics, *Turbulent flow, *Open channels, Channels, Prediction, Projections, Mathematical models, Mathematical equations, Hydraulics, Hydraulic properties, Fluid mechanics, Hydraulic structures, Open-channel flow.

This discussion suggests that the authors of 'Turbulence Prediction in Open Channel Flow', R.-M. Li, J. D. Schall, and D. B. Simons, mainly reiterate what is already known about turbulence characteristics in channels and about the formulation of the prediction model. It is pointed out that the basic assumptions, the subsequent derivation, the model for predicting turbulent intensities of velocity for the streamwise and crosswise directions in open channel uniform flow, and the concluding observations about the values of model parameters are exactly similar to the ones already published by R.-M. Li along with Shen. In addition, the proposed model may underestimate the maximum turbulent intensity and is unable to estimate the turbulent intensity near the boundary. (See Abstract No. W80-04645 for subject paper) (Carroll-FRC)
W82-03781

DISCUSSION OF 'VISUALIZATION OF SEPARATION OVER SAND WAVES',
Burlington (Ontario). Canada Center for Inland Waters,
P. Engel, and Y. L. Lau.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY3, p 386-388, March, 1981. 2 Fig, 2 Ref.

Descriptors: *Flow separation, *Sand waves, *Measurement techniques, Flow around objects, Flow characteristics, Flow pattern, Hydraulic profiles, Fluid mechanics, Mathematical equations, Mathematical models.

This discussion of the article 'Visualization of Separation over Sand Waves' suggests that, while the proposed method for measuring flow separation lengths over sand dunes is a step forward in providing information for the development of semi-analytical models for determining dune length, the analysis of the data is not entirely correct. The results obtained by the authors of the article, M. E. Karahan and A. W. Peterson, also differ from those obtained from recent experiments conducted by the writers of this discussion. It is suggested that the comparison between dunes and rectangular reversing steps used by the authors is not justified because of the totally different geometries of the two boundaries involved. (See Abstract No W80-06821 for subject paper) (Carroll-FRC)
W82-03783

EFFECT OF PERFORATION SHAPE AND PATTERN ON THE PERFORMANCE OF DRAIN PIPES,
Rijksstation voor Landbouwtechniek, Merelbeke (Belgium).
W. Dierickx, and W. H. Van Der Molen.
Agricultural Water Management, Vol 4, No 4, p 429-443, December, 1981. 4 Fig, 1 Tab, 26 Ref.

Descriptors: *Drainage, *Pipes, *Performance evaluation, *Perforated drain pipes, Mathematical studies, Simulation, Model studies, Drains.

An assumption was made in earlier calculations of the entrance resistance of perforated drain pipes that no important error is introduced by not taking into account the presence of the pipe wall as an impermeable surface. An electrolytic model was used to test this assumption. It was determined that the calculated values were about one half of the measured entrance resistance values. Addition of a central source of strength which was half the total strength of the sinks that simulate the perforations simulates an impermeable wall and allows exact results to be obtained. This was shown by accurate mathematical calculations derived for particular cases. Modified formulae have been derived for continuous longitudinal slits, circular perforations and discontinuous longitudinal slits. (Baker-FRC)
W82-03792

NUMERICAL MODEL OF LANDSLIDE-GENERATED WAVES,
Tetra Tech, Inc., Pasadena, CA.
W.-L. Chiang, D. Divoky, P. Parnicky, and W. Wier.
Report T-3427, November, 1981. 272 p, 40 Fig, 5 Tab, 72 Ref, 2 Append. 0-07-81-S0134.

Descriptors: *Landslides, *Rockslides, *Waves, *Mathematical models, *Computer models, Wave propagation, Dams, Flooding, Overtopping, Dam safety, Earthquakes, Earthquake flood, Model studies.

It is possible for a large land mass to become loose and plunge into a nearby water body under certain conditions such as earthquake, bomb expolosion, or heavy rain, especially after fire. When a large landslide intrudes into a large body of water at a high speed, a huge water wave can be generated. A numerical model was developed to simulate the generation, propagation, and dissipation of rockfall or landslide-generated water waves in bays, lakes, reservoirs, fjords, and rivers. Such waves are a major cause for concern in the vicinity of dams which may be overtopped and damaged, with flooding downstream. Other areas of concern include damage to intake structures, spillways, powerhouses, and shoreline structures. The core of the LSWAVE model is a hydrodynamic submodel which simulates the propagation of waves generated by other sub-routines. There are three wave generating submodels built into LSWAVE. The basic submodel generates the wave caused by a forced landslide, so called because the motion of the landslide is forced to follow a predetermined time-history. The second submodel computes the motion of a slide based on the initial position, size, and shape of the slide mass, topography, and other physical parameters. The third submodel produces a wave associated with a simple bottom up-lift which can occur near a fault line. The model has been tested by comparison with two physical model studies and one case history, and found to produce satisfactory results. (Moore-SRC)
W82-03971

FLOODFLOW CHARACTERISTICS OF THE SACRAMENTO RIVER IN THE VICINITY OF GIANELLA BRIDGE, HAMILTON CITY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-03985

THE USE OF A PERFORATED BAFFLE AT THE INLET OF RECTANGULAR SETTLING BASINS,
Sao Paulo Univ., Sao Carlos (Brazil). Escola de Engenharia.
L. Di Bernardo, and M. F. Giorgetti.
Journal of the American Water Works Association, Vol 72, No 9, p 528-533, 1980. 14 Fig, 3 Tab, 8 Ref.

Descriptors: *Baffles, *Design criteria, Basins, *Settling basins, *Wastewater treatment, Reynolds number, Mathematical studies, Jets, Nozzles.

A pilot study was conducted to determine the optimum distance required for intermixing to occur between the jets of neighboring ports in a perforated baffle and the effect of Reynolds number on that distance. The use of small nozzles in place of a circular orifice was also explored. Approximately 100 experiments were performed during the course of this research. The experiments were conducted using one circular orifice, two circular orifices, one nozzle, and two nozzles. The space between port centers in meters is represented by S, and the distance required for intermixing of neighboring jets in meters is represented as X. The study concluded that X/S is almost constant for a fixed value of Reynolds number based on the orifice velocity and diameter. For the same Reynolds number, X/D (D = port diameter in meters) varies linearly with S/D. For Reynolds numbers between 10,000 and 30,000, X/S varies between 4.5 and 3.0. Jets coming from nozzles diffuse in a shorter distance than those coming from circular orifices. The use of nozzles to replace ports in a perforated baffle wall may become advantageous when it is considered that the thickness of a baffle wall typically varies between 0.05 and 0.20 meters and that the nozzles can be executed within the wall thickness. (Baker-FRC)
W82-04124

8C. Hydraulic Machinery

PRACTICAL POWER-SAVING TECHNIQUES IN PINELLAS COUNTY,
Jones, Edmunds and Associates, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5F.
W82-04092

PUMP SYSTEMS: WHAT PRICE INEFFICIENCY,
Burns and McDonnell, Kansas City, MO.
R. A. Daffer Jr., and J. M. Price.
Journal of the American Water Works Association, Vol 72, No 6, p 338-343, June, 1980. 11 Fig, 2 Tab, 3 Ref.

Descriptors: *Pumps, *Motors, *Operating costs, Energy, Hydraulic machinery, *Water supply systems, Economic efficiency, Design criteria, Optimization, Economic efficiency.

Energy savings in water pumping system design should be based on total system analysis, from proper pump selection to proper driver selection. High efficiency electric motors cost 15-25% more than standard models but usually pay back the added cost within 2 to 4 years. Motor efficiency is highest at 50-125% of rated output and drops significantly below 50%. Therefore, motors should not be greatly oversized. Pumps, typically 50-90% efficient, should be designed to reduce flow, if necessary, by use of multispeed motors or variable speed drives. Motors and pumps should be connected directly, not by gears, belts, or slip couplings, for greatest efficiency. Pump conditions should be closely matched to actual operating con-

ditions. Examples are given for a single pump system and multiple pump systems with constant speed drive, variable speed dirve, and continuously operating base flow systems. (Cassar-FRC)
W82-04093

PUMPING STATION RELIABILITY: HOW AND HOW MUCH,
Ionics, Inc., Watertown, MA.
H. C. Valcour, Jr.
Journal of the American Water Works Association, Vol 72, No 4, p 187-191, April, 1980.

Descriptors: *Design criteria, *Pumping plants, *Water distribution, Reliability, Water supply, Maintenance.

This paper summarizes factors that determine the reliability of a water pumping station, the adverse conditions a station must be able to withstand, and the means presently used to ensure this reliability. A classification scheme for water pumping stations is suggested. This consists of four grades of reliability. (1) Failure of the station even momentarily would significantly endanger human life and/or result in property loss. (2) Failure for 60 sec or more would result in loss of the only available water for a given industrial operation or population for nonpotable use or fire fighting. (3) Failure of flow could be tolerated while water of equivalent quality is available from storage. (4) Failure of flow can be made up from alternate sources for long periods. Design criteria may be divided into four categories: facility (location, building, power source, etc.), process (number of units, pump ratings, etc.), component (pumps, motors, chemical feeders, etc.), and maintenance (frequency, materials needed, etc.). Case histories are given for three specific water plants. Measures taken to improve reliability in these situations included a partition to prevent internal flooding of the building, a reserve storage tank at a remote telemetered plant, and vandalproofing. (Cassar-FRC)
W82-04110

WATER LEVEL CONTROL FOR SMALL HYDRO PLANTS,
Norsk Elektrisk and Brtown Boveri A/S, Oslo (Norway).
H. E. Horn, and J. Bergseng.
International Water Power and Dam Construction, Vol 33, No 11, p 45-48, November, 1981. 9 Fig.

Descriptors: *Hydroelectric plants, *Control systems, *Water level recorders, Automation, Energy, Powerplants, Small reservoirs, Effective capacity, *Norway.

Energy output of small hydroelectric plants can be optimized with accurate water level measurement and control techniques for the inlet dam. Small reservoirs have limited ability to store water and compensate for periodic variation in the flow of the river. Therefore, setting the turbine to the expected minimum flow may cause overflow (and wasted power) at times. Reliability of water level measurements may be improved by measuring water pressure and guide vane position inside the powerplant. This data is processed by a computer to give water levels. A controller can be connected to the microprocessor for automatic adjustment of water levels. (Cassar-FRC)
W82-04173

SMALL HYDRO STATIONS IN SWEDEN,
Swedish Power Association, Stockholm.
T. Persson.
International Water Power and Dam Construction, Vol 33, No 11, p 54-57, November, 1981. 7 Fig, 5 Tab.

Descriptors: *Hydroelectric plants, *Water resources development, *Urbines, *Sweden, Design criteria, Small hydropower plants.

In Sweden 80 small hydroelectric plants are operating at present. When the planned 1300 stations are on line, they can supply a total of 2100 GWh per year to the national grid. Most of the development work has concentrated on a propeller type turbine with fixed or movable blades and fixed guidevanes. Eight prototype plants were built in 1976-70 with finacial help from the Swedish Industrial Board. As a result of this research design criteria were developed. Additional grants were given for 80 more mini hydro stations. (Cassar-FRC)
W82-04174

8D. Soil Mechanics

A DECISION THEORY APPROACH TO EARTH DAM CLASSIFICATION,
Maryland Univ., College Park, Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W82-04152

RECORDING UNCONFINED TENSION TESTER,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
C. R. Thorne, N. K. Tovey, and R. Bryant.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, No GT11, p 1269-1273, November, 1980. 3 Fig, 8 Ref.

Descriptors: *Soil strength, *Soil analysis, *Soil physical properties, *Testing procedures, *Experimental data, Soil science, Soil compaction, Slopes, Soil stability, Erosion, Laboratories, On-site investigations, Stress, Data collections, River banks, Embankments.

Apparatus for testing tensile stress in soils has been developed. It was designed for use in the field, e.g., on river banks, requiring minimal sample preparation and no external power or equipment. The apparatus uses weaker springs than those supplied with a compression tester, because very low levels of stress are involved. The pantograph which records the stress-deformation curve is modified, as are the recording charts, to account for the decrease in cross-sectional area of the sample which accompanies axial strain. Paraffin wax is used to bond the soil to end caps which connect to the apparatus mechanically. The apparatus has proved successful for all the alluvial silt and clay soils tested to date; however, it may not be strong enough to test compacted soils. (Titus-FRC)
W82-04238

8F. Concrete

PROBLEMS OF LIGHTENING UNDERGROUND STRUCTURES AND METHODS OF CONSTRUCTING THEM UNDER PERMAFROST CONDITIONS,
For primary bibliographic entry see Field 8A.
W82-03918

8G. Materials

PERFORMANCE STUDIES OF VARIOUS LANDFILL AND IMPOUNDMENT LINERS,
Soil Testing Services of Wisconsin, Inc., Green Bay.
For primary bibliographic entry see Field 5E.
W82-03938

AN EXPERIMENTAL APPROACH TO CORROSION CONTROL,
Philadelphia Suburban Water Co., Bryn Mawr, PA.
For primary bibliographic entry see Field 5F.
W82-04099

MONITORING AND CONTROLLING CORROSION BY POTABLE WATER,
Middlesex Water Co., Woodbridge, NJ.
For primary bibliographic entry see Field 5F.
W82-04100

THE BEHAVIOR OF ASBESTOS-CEMENT PIPE UNDER VARIOUS WATER QUALITY CONDITIONS: A PROGRESS REPORT,
Environmental Protection Agency, Cincinnati, OH.
R. W. Buelow, J. R. Millette, E. F. McFarren, and J. M. Symons.
Journal of the American Water Works Association, Vol 72, No 2, p 91-102, February, 1980. 1 Fig, 16 Tab, 11 Ref.

Descriptors: *Pipes, *Asbestos cement, *Corrosion, *Water distribution, Water analysis, Aggressiveness index, Water quality, Hardness, Acidic water, Water pollution sources.

The action of waters with agressive indexes of 5.34 to 12.85 on asbestos cement pipe was studies by counting asbestos fibers in water samples from 10 systems with varying water quality. Pipe loop tests were also conducted. Loose asbestos fibers were found in waters with agressiveness indexes up to 10.48, but not over 11. Pipes in systems with agressive water (index under 10) showed visible deterioration, except for one, which was coated with an iron rust-like material. Agressiveness index, pH, alkalinity, and hardness, considered singly, were not sufficient to predict the presence of loose asbestos fibers or pipe deterioration. Metals such as Zn, Fe, and Mn appeared to have a protective effect on pipe walls at the low temperatures common in water distribution systems. Tapping the pipe for water samples liberated fibers into the water supply. Representative samples should be taken in pipe lengths with sufficient flow to cleanse the pipe of debris. (Cassar-FRC)
W82-04119

KEEPING A CENTURY-OLD WATER SYSTEM YOUNG,
R. A. Jackson.
Journal of the American Water Works Association, Vol 72, No 9, p 492-495, 1980. 3 Fig.

Descriptors: *Maintenance, *Water costs, Economic aspects, *Pipelines, Pipes, Corrosion, Leakage, Design criteria, Construction, *Richmond, Virginia, Water supply systems, Water mains.

The water distribution system in the city of Richmond includes about 1700 km of water mains ranging in size from 2 to 48 inches. Some of the equipment still in use, such as pipe, dates back to 1832, when the first true pressure water pipe installed was cast iron. In 1970 the city adopted ductile iron pipe as the standard for system piping. Annexations between 1942 and 1970 have been made with asbestos-cement (A-C) pipe. Tests have also revealed good service with prestressed concrete and PVC pipe. Until the mid-1930's a tar coating was the only protection given the cast iron piping in Richmond's distribution system. As a result, severe internal tuberculation has plagued this piping. Various methods of joining different types of pipe have been employed over the years, including mechanical joints and push-on joints. Tapping procedures, service connections, system valves and fire hydrants are briefly considered. (Baker-FRC)
W82-04138

CONTROLLING THE COST OF SYSTEM MAINTENANCE,
Los Angeles City Dept. of Water and Power, CA.
W. W. Hoye.
Journal of the American Water Works Association, Vol 72, No 9, p 501-505, 1980. 7 Fig.

Descriptors: *Maintenance. *Water costs, Economic aspects, Cost analysis, Pipelines, Pipes, Systems analysis, Corrosion, Leakage, Water loss, Budgeting, *Water supply systems, Water mains, *Los Angeles.

Common sense cost-cutting measures can be inaugurated by utilities when it is necessary to further reduce already lean budgets for pipeline maintenance. The Los Angeles water system covers 1200 square kilometers with 11,100 km of pipeline. The system includes 630,000 services and 50,000 fire hydrants. Minimizing pipe failure costs is essnetial,

especially as the distribution main leak repair and maintenance costs are increasing. Preventive measures become important. Pipe repair costs are minimized by the use of standard materials. A corrosivity investigation helps ensure that a beneficial, noncorrosive environment exists where the pipes are to be placed. Cathodic protection is given to steel pipe for both main line installations and repair work. Sand backfill is employed for cast iron repairs. The cost over which field supervisors have the most control is labor. In 1974 the Los Angeles department initiated a study program of field construction and operation and maintenance procedures. The program goal is to achieve the most efficient crew sizes in order to enable each employee to provide a full day's work. Major pipe repair cost savings were achieved as a result of the study of leak crews. In 1976 main line construction work was also examined; a consulting firm retrained seven workers in analytical methods and to provide technical and field assistance. Work standards and job classification modifications have also been instituted. The department's general services division has several new programs designed to lower equipment costs. (Baker-FRC)
W82-04139

8I. Fisheries Engineering

MICROHABITAT SELECTION BY FISH: A RATIONALE FOR DEVELOPING DESIGN CRITERIA FOR MITIGATION DEVICES IN CHANNELIZED STREAMS,
Cooperative Fisheries Unit, Columbus, OH.
R. Carline, and R. Stein.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-197914, Price codes: A03 in paper copy, A01 in microfiche. Report No 712432, May, 1981. 21 p, 7 Fig, 5 Tab, 1 Append. A-058-OHIO(1).

Descriptors: *Bass, *Fish behavior, *Stream improvement, Warm-water fish, Streams, Rivers, Fish, Aquatic habitats, Ecology, Light intensity, *Fish management, Fish populations, *Smallmouth bass, *Micropterus dolomieui, Microhabitat selection, Channelization, Stream tank, Substrate, Habitat selection, Cover, Research technology, Ohio.

Microhabitat selection by juvenile (14-16 cm total length) and adult (24-26 cm) smallmouth bass was examined in a laboratory stream tank to determine the importance of four physical factors: light, current velocity, substrate, and cover. Effects of light were tested in a gradient (30-4000 lux, dark end upstream), a reversed gradient (30-4000 lux, light end upstream) and at a low uniform light level (50-250 lux). High (1-47 cm/s) and low (0-20 cm/s) current velocities were tested. Substrates included sand (1 mm), gravel (15-40 mm), boulders with cobble filler (250 mm with 50-100 mm), and boulders with cobble removed. Three types of clear and opaque covers were tested in areas of the stream tank with fast and slow current: flat overhead covers at the surface, flat overhead covers at middepth, and open-ended box covers. Fish preferred low current speeds (7 cm/s), low light levels (250 lux), and cover that provided low current and light levels. Substrate was not important when it did not provide cover for the fish. Juveniles selected slightly lower current speeds and light levels than adults. We selected the Flat River in Michigan, a shallow, clear stream with an abundant smallmouth bass population, to test lab generated hypotheses. Two stations were selected in the river, one for behavioral observation with minimal human disturbance, the second for experimental manipulation of physical factors to explicitly test lab generated hypotheses. After observations of bass in these stations using several techniques we found binoculars to be the best method of precisely determining bass positions and behaviors.
W82-03955

EVALUATION OF A SMALL DIAMETER BAFFLED CULVERT FOR PASSING JUVENILE SALMONIDS,
Pacific Northwest Forest and Range Experiment Station, Juneau, AK. Forestry Sciences Lab.
M. D. Bryant.
Forest Service Research Note PNW-384, April, 1981. 8 p, 4 Fig, 9 Ref.

Descriptors: *Culverts, *Salmon, *Trout, *Fish passages, *Baffles, Fish migration, Juvenile growth stages, Scour, Outlets, Flow discharge, *Alaska.

Poorly constructed road crossings of small streams can block upstream movement of juvenile salmonids. Where gradients are more than 1%, baffled culverts may facilitate fish passage to nursery areas above road crossings. The baffles create a series of short high velocity runs between the baffles and a series of low velocity backwater areas behind the baffles. These areas allow the fish to swim in short bursts and then rest. A 90-cm diameter culvert with off-set baffles was set at a 10% gradient in an artificial stream channel on Admiralty Island, Alaska. Juvenile coho salmon, Dolly Varden, and cutthroat trout used in the study were taken from two nearby streams. All fish, with the exception of a few larger (110 to 120 mm) Dolly Varden, were less than 100 mm fork length. All three species were able to negotiate the culvert, but more Dolly Varden than coho salmon or cutthroat trout were successful. Within the range of discharges commonly examined between 10 l/S and 16 l/S, discharge did not appear to affect fish movement up the culvert. Two potential problems with baffled culverts may occur at the outlet: outlet velocity; and scour of the stream bottom. Both can be avoided by proper design. (Moore-SRC)
W82-04075

FREQUENCY OF LOW DISSOLVED OXYGEN CONCENTRATIONS IN PONDS FOR COMMERCIAL CULTURE OF CHANNEL CATFISH,
Alabama Agricultural Experiment Station, Auburn.
C. E. Boyd, J. A. Steeby, and E. W. McCoy.
In: Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies, Vol 33, 1979. Southern Association of Fish and Wildlife Agencies, Nashville, Tenn. 5 Fig, 4 Tab, 9 Ref. OWRT B-076-ALA(8).

Descriptors: *Dissolved oxygen, *Catfish, *Ponds, *Aeration, Crisafulli pump, Phytoplankton, Photosynthesis, Fish mortality, Plankton density, DO meter, Tallahatchie County, Mississippi, *Fish farming.

The problem of low dissolved oxygen (DO) problems in pond culture of channel catfish was studied in 36 ponds in Tallahatchie County, Mississippi in 1978. DO readings were taken at dawn and midafternoon during the 154-day period 1 May through 1 October. Of particular concern for DO-deficiency fish mortality were readings below 2 mg/liter as measured with a polarographic DO meter and thermister at a depth of approximately 15 cm. Readings below 2 mg/liter occurred most frequently at dawn when water temperature exceeded 26 C; 20% or more of the ponds showed this low reading. Emergency aeration of these ponds was accomplished by using one of three methods: paddle-wheel aerators beat air into the pond; lift pumps pulled in water from an aerated adjacent pond; or Crisafulli pumps brought up water from the pond and sprayed it through the air onto the surface of the pond. Emergency aeration was employed 410 times; at least 1 pond was aerated most nights, with a maximum of 9 ponds on a single night. Findings suggest 1 aerator for each 4 ponds. (Mullen-IPA)
W82-04083

WATER QUALITY AND OFF-FLAVOR PROBLEMS IN COMMERCIAL CHANNEL CATFISH CULTURE IN WEST-CENTRAL ALABAMA,
Auburn Univ., AL.
For primary bibliographic entry see Field 5C.
W82-04087

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WATER USE DATA--WHO NEEDS IT,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7C.
W82-04198

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INFORMATION MANAGEMENT: A ROLE FOR PRIMACY AGENCIES IN THE 80S,
Utah Dept. of Health, Salt Lake City. Bureau of Public Water Supplies.
K. H. Bousfield.
Journal of the American Water Works Association, Vol 73, No 10, p 519-523, October, 1981. 5 Fig.

Descriptors: *Water quality, *Information systems, *Information retrieval, Standards, Data processing, Automation, Data storage and retrieval, Data collections, Data acquisition, *Safe Drinking Water Act.

In order to meet the requirements of the Safe Drinking Water Act (SDWA), a state primacy agency must gather and evaluate a large amount of information. An electronic data processing system was used at the Utah Bureau of Public Water Supplies to aid in gathering the needed information. Before such an electronic data collecting system can be selected, certain criteria must be met. In this case the staff had to be able to access data easily for review, the programming language had to be simple, a means had to be devised to avoid data entry error due to name variations, storage capacity had to be sufficient to allow information concerning each water system including 5 years of bacteriological data and 10 years of chemical data to be retained, and both initial and operation and maintenance costs would have to be within the budget. The data base used calls for the division of the data into four separate files: physical facilities file, water source file, chemical file and bacteriologic file. At least 36 different standard reports can be generated from this data base, each with interest for specific individuals on specific individuals on specific questions. In addition to standard reports, the bureau can now provide a real service to water system managers and operators. Additional development is planned for the future as new standards for chemical constituents as well as changes to existing standards are proposed by the Environmental Protection Agency. (Baker-FRC)
W82-03891

ACCESS TO WATER-RELATED DATA IN TEXAS,
Texas Department of Water Resources, Austin.
D. L. Ferguson.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 375-383, October, 1981. 4 Fig, 3 Tab.

Descriptors: *Information systems, *Data storage and retrieval, *Water resources, *Texas, Information exchange, Information retrieval, Computers, Data collections, Data transmission, *Texas Natural Resources Information System, Remote sensing, Maps, Indexing.

The Texas Natural Resources Information System (TNRIS), Austin, is a mechanism for storing, processing, and disseminating information on the state's water and other natural resources. The TNRIS is affiliated with the state government. It has evolved since the 1960's making use of existing facilities. Information is provided to users in government, education, water districts, river authorities, and the private sector in 6 categories: hydrological, biological, meteorological, geological, socioeconomic,

and base data (maps and remotely sensed data). The 300 automated files and 150 manual files indexed in the system are accessed by computer terminal, telephone or letter. The system also interfaces with other data bases. Output is supplied in many forms, such as computer printouts, graphs, interface with remote terminals, and indexes. During the 1979 fiscal year, 4088 outputs were generated; 89% of the requests were by telephone, letter, or in person, and 11% by computer terminal. Total operating costs for the 10 years, 1969-1979, were about $2.5 million. (Cassar-FRC)
W82-04000

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